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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

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A Highway Number

AS IS customary the week preceding the annual convention of the American Road Builders' Association more than the usual amount of space in this issue is devoted to the subject of highways. The material covers a wide range, including articles on the bituminous, brick and concrete types of construction, in addition to other features dealing with cost-keeping methods and the operation of construction plant. Highway engineers and contractors will do well to study carefully the contents of this issue. They will face, this spring, a far larger task than has ever before been imposed upon them—that of putting through a construction program involving, according to present estimates, an expenditure of about $650,000,000. With this vast amount of work in prospect, every means of saving time, whether it be in the form of systematized office and field work or more efficient construction plant or methods, should immediately be put into practice. Engineers and contractors should be on the alert to apply to their work any idea that will help in the process of speeding up. That is why the technical journals now, as never before, should be closely scanned for constructive suggestions applicable to road construction.

Concrete Institute Waking Up

FOR fifteen years the American Concrete Institute has been leading a more or less precarious existence. Its value as a technical society has never been questioned and its proceedings have maintained a high standard of excellence. Nevertheless, it has never attracted the membership it deserved or impressed its standards on practice to the extent their undoubted authority warranted. Happily, a better day is in sight. The Board of Direction has realized that a good thing sometimes has to be pushed, that virtue deserves more than merely being its own reward. Accordingly, the Board has started a campaign of publicity and a drive for more members. Periodical letters are being sent to members to keep alive their interest between conventions. New committees have been appointed and are active in the study of some of the important questions in the concrete field. A live, active meeting is planned for Chicago in February, where these committees will report. Taken together, the prospects are very bright and every engineer, architect or contractor interested in concrete will soon have to decide whether he can afford to remain outside the membership.

New Start for Garbage Reduction

WHAT may prove to be a new start for garbage disposal by the reduction process is reported from Rochester, N. Y., which has just let a contract for a complete garbage-reduction plant. During and since the war no important garbage-reduction contracts appear to have been let, if, indeed, any whatever has been awarded. Meanwhile, several reduction plants have been shut down in the sweeping movement for garbage disposal by feeding to hogs. Perhaps the tide of hog feeding has now turned back and we may see a wave of disposal by reduction. Conditions at Rochester, however, pointed quite strongly toward reduction, particularly since the city not very long ago acquired a private reduction plant located in the center of the city. With a site for disposal by reduction already established, which also had the advantage of central location, and with past experiences to indicate opposition to the establishment of any system of garbage disposal, whether by feeding to hogs or otherwise, in outlying districts of the city, it is not surprising that Rochester decided to continue to dispose of its garbage by reduction. The matter has been gone into very carefully by the engineering department of the city and a plant of ample capacity, as it is thought, has been contracted for in the hope of avoiding some of the difficulties that appear to have arisen elsewhere through the operation of under-sized garbage-reduction plants.

Railroad Finance and "Value"

IN any discussion of a new rate rule and the distribution of "excess" earnings, either directly or by compulsory mergers, the great change taking place in the whole principle of railroad finance must be taken into consideration. Is not the principle changing from finance for profit to finance for security of investment? If we may assume that the change already has taken place, then the valuation finally to be fixed upon properties assumes proportions of importance greater than before. The outline of elements constituting "true value," which appears on p. 271, may readily serve as a "basis for argument," to quote the author. The physical value of a strong road may be no more than that of a similar weak road, but the intangible value of the former, based on income-producing qualities and prospects of the future, may be very much greater. There appears no doubt that the strong systems will make a desperate fight against the limitation of "excess" earnings on the basis of physical value—a fight that can be settled only in the Supreme Court. Determination of intangible value at once becomes the center of the controversy. While not entirely in accord with Mr. Morse's outline in designating the ultimate elements of this value as cost of reproduction and allowable rate of return, we believe that such an analysis throws much light on the present difficulties of the Congressional conference committee engaged in drafting a final railroad measure.

Short Cuts in Estimating

SHORT CUTS in making up bidding figures are a necessity and also a danger of highway contracting. With a great mileage to plan, and ordinarily with a small force of planning engineers, highway officials,

more often than not, are able to furnish the bidder with complete plans only a few days before the time set for receiving bids. Often in the past season's construction the bidder has had the full plans in his possession only 48 hours. In such instances, short cuts in computing bidding prices are essential if unit-price bids are to be based on estimates and not on guesses. Every experienced highway contractor has short-cut methods of making estimates. They differ widely in scope and accuracy. On page 261 of this issue is published a short-cut method of utility greater than ordinary, which one contractor has found helpful in estimating the cost of concrete paving. Help in computing costs is all that the best short cut can furnish. As the successful painter, to quote a famous remark, must mix his colors with brains, so the successful estimator of highway construction costs must mix his short-cut processes with practical knowledge of the conditions and circumstances which influence construction costs. Used with the discretion and the intuition begotten of experience, the charts which are published on page 261 will be found helpful. Used as the tyro may conclude he may use them, without being carefully "mixed with brains," these charts can be dangerous.

Has It Been Worth While?

IRRIGATION engineers deal so frequently with estimates and with prognostications that a retrospect of accomplishment measured in money as well as other things is needed to bring back to them a realization of their contribution to the world's welfare. Statistics of results obtained on the Minidoka Project of the United States Reclamation Service have recently been compiled, and are a surprise even to those most closely connected with the project. In 1904 the area was sagebrush desert. The expenditures have been $5,800,000, $1,000,000 of which has been repaid. The land, livestock and farm equipment values created exceed $30,000,000, while the crops produced in 1919 by the 110,000 acres of cropped land brought nearly $6,000,000. The cumulative figure of crops raised since 1909 is $25,000,000. More than 1,000 men were sent to war, and $2,000,000 were subscribed to Liberty Loans and other war activities. Over 11,000 of the 17,000 persons on the project have deposits in the 10 banks. Seven newspapers, 25 churches and 28 schools supply the educational needs. Among the industries which have sprung up are two sugar factories, five cheese factories, three flour mills, one brickyard, one potato-drying plant, two alfalfa mills, one mixed-feed mill and two feeder yards. Fifty-two miles of railroad have been built. The 10,000 hp. generated at the project power house pumps water for 52,000 acres, in addition to supplying all towns, factories and more than 800 farms. The work surely has been worth while.

Consulting Income and Costs

HOW one engineer is dealing with conditions incident to the shrunken dollar is a short story that recently came to our attention and will bear repeating for the possible benefit of other engineers. After listening to an address in which stress was laid upon the recent depreciation of the purchasing power of the dollar, this engineer went back to his office and started an investigation as to how his income had been running for some years past. He found that in the past dozen years, although his professional fees had been doubled and his working staff largely increased, his net income was about the same as at the beginning of the period. He thereupon decided to increase his professional fees by half. In relating this story, the engineer remarked that there seemed to be no reason why men in commercial life should make so much more money than engineers. He followed this statement immediately by the question, "What are engineers going to do about it?" He added, "There is one thing to be done—they must produce more or get better results from their work." That he had not overlooked the question of production efficiency in his own office is shown by the fact that from himself down there is kept for every person in the office a time report accounting for every hour of the day and allocating it to some particular piece of work. How many engineers have made similar studies of their income over a period of years and have acted upon the lessons that such a study, in the majority of cases, would probably bring out? How many keep time records such as that mentioned?

Do Shippers Want a Railroad Subsidy?

SURPRISING as it may seem, in the face of a serious shortage of transportation facilities, a large body of the country's shippers has presented a memorial to a Congressional conference committee advocating a return to the old Interstate Commerce Commission form of regulation—the very form of regulation as to rates and operating functions that has resulted in the present situation, through restriction of railroad credit. The National Industrial Traffic League, representing a majority of the large shippers, has gone on record opposing the two provisions of the Cummins bill designed particularly to restore credit and provide an adequate Federal regulation; namely, the establishment of a more definite rule of rate-making and the creation of a Federal Transportation Board charged with maintaining efficiency.

Experience has clearly shown that it is not enough merely to say that rates shall be "just and reasonable." More definite assurance of return on investment must be given to attract the billions of dollars in new capital necessary in the next few years to prevent a serious shortage of all railroad facilities. True, the more definitely fixed the minimum rate of net return, the greater will be the demand for restricting "excess" earnings, as the element of risk is eliminated. The Cummins bill would restrict "excess" earnings by so rapidly an increasing proportion as, in our judgment, to discourage efficiency of management and possibly to promote over-maintenance of prosperous systems. The recent split of the railway executives on the question indicates that some believe the fixed return feature is the best bargain obtainable in view of present public sentiment. Unfortunately, the division of opinion appears to be between the executives of the more prosperous as opposed to those of the less prosperous lines. But why should shippers, confronted with curtailment of production through a transportation shortage, oppose legislation designed to bring about the needed development?

The shippers—rather the representatives of a large body of them—also oppose the creation of a Transportation Board on the ground of conflicting authority with the Interstate Commerce Commission. It is the purpose of the Cummins bill that Government regulation

be divided as to operating and judicial functions, recognizing the need of a better adjusted regulation after the failure of the Commission successfully to cope with operating matters. Lines of authority between the two bodies can be drawn as tightly by wise legislation as between departments of a private enterprise by a strong management.

When the joint conference committee of Congress renders its report we hope that the debate will clarify the position of the shipping interests. Surely shippers do not want a continued and more serious restriction of their production through lack of distributing facilities. Surely they recognize that huge sums in new capital must be furnished to relieve the situation. If adequate assurance is not given to justify the new investment, and if it is not encouraged, it will not be made except by Government subsidy. The recent proposals of the "National Shippers' Conference" point toward an attempt to force continuance of transportation at less than cost, with a broad hint at extending the subsidy considerably beyond the transition period following the return of the roads. Can it be that shippers in general actually favor such a policy—a policy that can have only the ultimate result of out and out Government ownership and operation, with a heavy burden upon the country's business through taxation or through higher and still higher rates?

Efficiency in the handling of traffic—which is to the ultimate benefit of the shipper—cannot be obtained unless the rates are such as to cause a flow of capital into railroad securities.

A Municipal Responsibility

A NEW element has made its appearance in the field of engineering thought within the year, as a result largely of the financial troubles that beset the street-railway services. Urban transportation, something that in the past took care of itself automatically (and we cared not how efficiently) came to need attention. It revealed itself as a problem of size and importance. Municipal engineers in many cities were compelled to deal with it, and in consequence they are now inclined to recognize it as their own problem. For a decade or more the trend of thought had been, unconsciously, toward this recognition, but now the movement is real and conscious. Cities and their engineers have had to grapple with questions of losing or maintaining long-established transportation services, of controlling the growth of bus lines, of providing terminal facilities—as at Los Angeles—of coördinating car and bus services for maximum use to the community. They have realized the new responsibilities quite concretely, and will not again abandon them. The subject is bound to be studied intensively, for urban passenger movement is an integral problem, including as separate parts all the various services from sidewalk to rapid-transit line and all detail problems from routing, capacity and schedules to service efficiency and cost. There is promise, to speak conservatively, that results of remarkable benefit to the community will flow from this study, for it will tend very directly to make our cities more efficient and less wasteful of space and energy in regard to business and living. Freight transportation awaits study thereafter, as a separate though closely related problem, and it is perhaps the more difficult of the two. Future developments of an importance that can hardly yet be estimated lie concealed in the present situation, in short. It may well be that, years from now, the line dividing 1919 from 1920 will prove to mark an epoch—the point at which urban transportation became a definite municipal responsibility.

M. I. T. and Consulting Work

AS PART of its recent campaign to raise an endowment fund of $8,000,000, the Massachusetts Institute of Technology made a strong drive to have industrial corporations contract with the Institute for consulting services. A bulletin sent out toward the close of the campaign stated that about forty corporations had signed contracts totaling about half a million dollars. The plan has been criticised by consulting engineers as a vigorous attempt to invade their field.

The contract under which this work is undertaken contains four chief provisions, as follows:

1. The company paying the retainer may use the library and files of the Institute and confer with its technical staff on problems pertaining to the business.
2. The Institute agrees to maintain a record of the qualifications, experience and special knowledge of its alumni, in order to assist the subscribing company to locate men equipped with special knowledge and experience.
3. The Institute agrees to maintain a list of its undergraduates and to advise the subscribing company with regard to the records and qualifications of these men.
4. The Institute agrees to advise the company where tests and research "can best be done, whether in Technology's laboratories by its own staff and students, or by some outside organization."

Whatever may have been said in the way of promotional publicity, the fact is that the above four items are the sole stipulation of the contract. It will be seen that the Institute legally binds itself to the doing of things which, in a more or less efficient way, are regularly done without charge by engineering colleges, and, as we see it, no one can properly criticise the Institute for doing them. The criticisms have been based not upon the provisions of the contract document, but on the flamboyant publicity which conveyed the impression that the Institute was embarking on a campaign to make itself the national consulting body of our whole industrial fabric. For example, we find this paragraph:

"Carried to its conclusion, the Technology Plan would make of M.I.T. the greatest consulting body in the world, since its range would cover practically every field of technical research, and it would follow that, since the great corporations of the country retained Technology as a consultant, the great experts of the country would ultimately be members of its instructing staff."

In some newspaper accounts it was stated that the Institute proposed to establish service bureaus in large cities to handle "the business the new idea has created."

The doing of research work for private parties by educational institutions is not new. The engineering experiment stations of Middle Western colleges and various engineering college laboratories in the East have done a considerable amount of such work. There has been no criticism of such activity, because the problems studied are generally of a character that cannot

be handled successfully by private consultants or consulting laboratories. Held within these bounds—of taking only such work as private laboratories are unwilling to undertake—there is not likely to be sustained criticism of the plan. In fact, we feel that the criticisms so far made are due to the taking in full faith of the imaginative flights of the campaign's publicity agents.

Obviously, the plan could be handled in such a way as to interfere with the practice of private consultants, but we have too much faith in the sound sense of the Institute's directors and of Dr. W. H. Walker, who is in direct charge of the plan, to believe that there will be any flagrant transgression upon fields where the private consultant can do satisfactory work. It is to be noted that the campaign propaganda, though not the contract, placed emphasis upon the research feature of the retainers. Obviously, there are not and will not be many laboratories conducted for profit which will be competent to engage in research work, and the plan, if it should not go beyond the field of research, is likely to be stimulating to the employment of engineers rather than otherwise. It will awaken to the importance of research many industrial corporations that now have no interest therein.

We should say, then, that results of the new plan should be awaited before the criticism is made positive, but it is worth while for engineers who have fears of the ultimate result, whether they be graduates of Technology or not, to express their views frankly to the officers of the Institute.

Organized Steel Research and Specifications

AN UNDERTAKING of quite remarkable character is made known by a current announcement. It is a systematic research into the effects of sulphur and phosphorus on the quality of steel, organized on an impressively large scale. Since the early days of steel chemistry the two elements in question have been known as enemies of good steel. That sulphur makes steel red-short and that phosphorus makes it cold-short or generally treacherous are axioms of steel practice. Not only practical observation but a very large amount of skilled scientific study supports these beliefs. However, as the elimination of sulphur and phosphorus increases the cost and difficulty of making good steel, it is desired to learn whether the present low specification limits can safely be raised. Dissatisfied with the slow progress of normal scientific research, the interested parties have decided upon a concentrated attack on the problem.

Organized research of this kind is decidedly new. Its theory appears to be that by carrying out a campaign of tests according to a program fixed in advance, data on which reliable conclusions can be based will be obtained, provided the program is sufficiently broad. By this procedure, it is thought, tangible results can be obtained very much more quickly than through the means of sporadic voluntary investigation, hitherto relied on. Back of this hope lies the fact that the present situation is such as to make it important to get results quickly.

During war-time pressure for steel production fuel and ore conditions made it impossible to maintain the low sulphur and phosphorus limits of accepted American specifications regularly, and at the present time the old limits have been restored only in part. It has been expected that full restoration will be brought about during the coming summer. From one point of view, then, it would be desirable to have preliminary results before summer, so that restoring the old limits could be postponed beyond the current year. But the subject is so complex that no significant results can be hoped for in so short a time, and in fact any attempt to utilize the investigation as a reason for postponing the restoration of the specification limits is likely to provoke a sharp fight in the ranks of the steel men themselves. Restoration is an obligation of honor, since the relaxation was agreed to only in view of war emergencies, and these have passed.

Broad-gage co-operation made this bold investigational undertaking possible. It is fine testimony to the forward-looking spirit that animates our technological activities today. Co-operation is a potent force. But in the present case of searching for hidden truths the mere setting up of a great organization, even though co-operative, will not assure results, any more than organized prospecting will discover gold.

In any event it must not be expected that results can appear very soon. Exceptional difficulties have to be overcome. The field to be covered is very large indeed, and every factor and phenomenon encountered in it is variable; yet observations on a few test pieces, representing a few of the infinite varieties of steel, must be relied upon. And the conclusions, to be worth anything, must have general validity, since, after all, what we seek knowledge about is not the steel of the test pieces but other steels subsequently melted and rolled. Bridging the gap between the limited test data and the broad conclusions will require scientific insight and genius of the same high type that is decisive in unco-ordinated private research, and this can not be supplied by mere organization.

The essential difficulty may be stated thus: While nominally phosphorus and sulphur are on trial, the real culprits may be metallurgical conditions of which these two elements are only chance companions. Steels with abnormally high impurities have been made that passed excellent mechanical tests. There are men who hold that at bottom the study is not of phosphorus or sulphur limits but of good steelmaking. And steelmaking is an art of such vast dimensions that the problem of a comprehensive research is rather appalling; such an investigation might fairly be expected to extend over a good many years.

It should not be forgotten, moreover, that we use steel, not on account of the presence or absence of certain chemical elements, but on account of the mechanical properties it possesses. We could get along without setting chemical limits if our acceptance tests were really exhaustive. A great deal of steel is made without being governed by sulphur limits in the specifications. In each case, however, the mechanical acceptance tests are severe. American practice has tended steadily away from completeness of mechanical testing, so that for example toughness, ductility and shock resistance are rarely made objects of commercial acceptance testing. It seems probable that in the course of full study of sulphur and phosphorus we may, while abandoning some of our traditional faith in chemical limits for steel, revise our conceptions of the most desirable scope of mechanical testing, to the benefit of economy of production and excellence of product.

Charts Tell Cost of Concrete Paving

Bidding Prices Determined from Curves Covering Wide Range of Physical Conditions and Variations in Wages of Labor and Prices of Equipment

By F. J. Herlihy
Winston Bros. Co., General Contractors, Minneapolis, Minn.

QUICK estimates of bids for concrete paving are made possible by a series of curves prepared and employed by the writer and illustrated in the accompanying five charts. These curves are of general application for the type of construction plant considered. With different wages and costs than those assumed in plotting the curves, the values given by the curves require to be modified by the percentages which the actual figures bear to those on which the curves are based. The curves and their application are explained in detail by the notes following the captions for the charts and by the following description.

The type of plant analyzed comprises steel batch boxes with dump bottoms, each holding the ingredients for a three-sack batch of concrete, mounted on 24-in.-gage

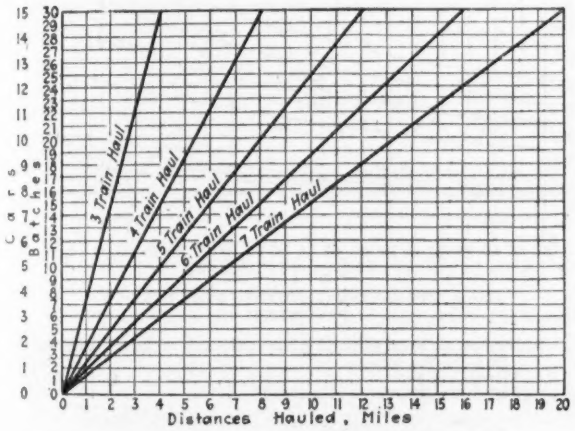


FIG. 1. NUMBER OF TRAINS REQUIRED TO HAUL ROAD MATERIALS

A 6-ton gasoline locomotive is used and a frictional resistance of 20-lb. per ton is assumed. Cars are 3-ton flats with brass journals. Each car carries two 24-cu.ft. batch boxes. The maximum train considered is 15 cars. Assumed loading time 2 minutes, and mixing time 2 minutes per batch. The loaded car weight is 3 tons. The average hauling speed is 8 miles per hour. The locomotive capacities are:

Grade, Per Cent	No. Cars	Grade Per Cent	No. Cars
Level	38	2½	10
1	18	3	8
1½	15	4	6
2	11	5	4

flat cars, two boxes to each car, drawn in trains by a six-ton gasoline locomotive from the charging bins at the material receiving point to the concrete mixer located just in advance of the paving.

The unloading plant consists of a travelling stiff-leg derrick operating a 1-cu.yd. clamshell bucket, the power being furnished by a three-drum hoisting engine with a boom-slewing attachment. A travelling bin having a capacity of 30 cu.yd., 20 cu.yd. for stone and 10 cu.yd. for sand, is provided, so constructed that it will travel on the same track as, and just in advance of, the stiff-leg derrick. Both the bin and the derrick will travel parallel to the spur track on which the cars of material are received. The sand and stone will be unloaded by the clamshell outfit into the travelling bin or into a long storage pile parallel to the line of travel and within easy reach of the derrick. The derrick will transfer the stored material to the bin when no material is available from cars. The bin is provided with four gates so located that the sand and stone may be spouted into four batch boxes simultaneously. A cement house, with large storage capacity, located contiguous and parallel to the material spur, is provided.

The concreting plant consists of a three-sack batch concrete mixer, a power tamping machine and the necessary pumps and pipe lines. The industrial track is composed of 20-lb. steel rail in sections, with steel ties and fastenings, laid on one shoulder of the roadway. At the material-receiving point this track is parallel to, and at the proper distance from, the charging bin to permit of spouting the sand and stone into the batch boxes, and passes through the center of the cement house. The mixer is provided with a derrick directly connected to it for picking batch boxes off the flat cars and dumping them into the elevating hopper on the mixer. All ingredients are placed in the batch boxes at the material-receiving point. A maximum of 15 cars per train with ingredients for 30 batches of concrete is considered.

Hauling Equipment Required—The ruling grade and the length of haul determines the number of trains required and the number of cars per train. The chart, Fig. 1, facilitates the computation.

This chart is constructed on the basis that it will require an average of 2 min. to mix and place each batch of concrete and that the same time will be consumed in placing the ingredients for each batch into the batch boxes. It naturally follows, then, that a minimum of three hauling trains will be required to keep the work going continuously. The horizontal lines in the chart indicate the number of cars and batches per train; the vertical lines represent the distances of the haul; and the diagonal lines show the number of trains from three to seven inclusive. The schedule following the caption of Fig. 1 indicates the number of loaded cars per train that can be hauled on grades varying from level to 5 per cent.

Knowing the maximum haul and the ruling grade, to find the hauling equipment required, pick out from the grade schedule opposite the grade corresponding to the ruling grade the number of loaded cars that can be hauled; next locate the horizontal line in the chart representing that number of cars; proceed along this line until it intersects the vertical line indicating the maximum distance of haul. The diagonal line immediately to the right of this point will indicate the number of hauling trains required. Where ruling grades are short and not too frequent, it will pay to use helper locomotives on these grades, in which case the next steepest grade to the helper grades should be used in applying the chart to find the number of cars per train and the number of trains required.

Plant Rental Charges—The chart, Fig. 2, shows the cost of plant rental per cubic yard of concrete for daily outputs of 100 cu.yd. to 200 cu.yd., in 25 yd. steps, for hauling plant, concrete plant and unloading plant. The

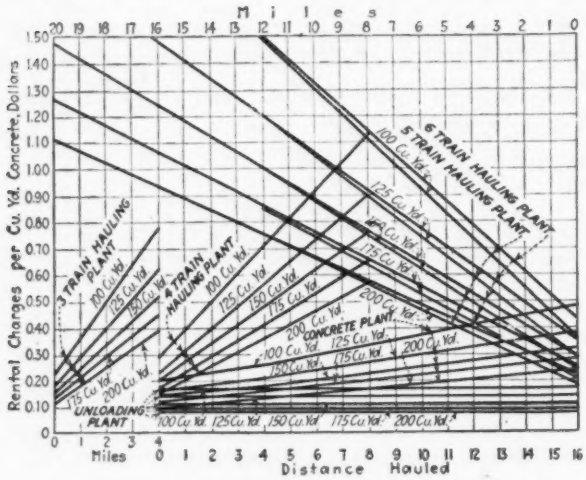


FIG. 2. PLANT CHARGES PER CUBIC YARD OF CONCRETE

Costs are shown for daily outputs of 100, 125, 150, 175 and 200 cu.yd., employing equipment indicated by Table I at the rental rates there given, and number and size of trains determined from the diagram, Fig. 1. An average train speed of 8 miles per hour is assumed. For each additional mile of pipe line add $1.50 per day, and for each additional 4 miles of pavement add $1.25 per day for booster pumps. Daily hauling equipment rental values are:

No. Trains	Minimum	Maximum
3	$21.99	$77.31
4	28.87	113.11
5	35.75	148.91
6	42.63	184.71

rental charges for equipment are based on the values per working day, including field and shop repairs, shown in Table I, and comprise only the units of plant which cannot be charged in their entirety against the job.

In the chart the vertical lines represent the distance or the length of the paving job from the material-receiving spur to the end of the pavement. On jobs where the material-receiving spur is located at some intermediate point, the distance between the material-receiving spur and the farthest end of the pavement should be used in applying the figures shown in the chart. The horizontal lines represent the values per cubic yard of concrete to be used in making rental charges and the heavy lines, both inclined and horizontal, show the daily output in cubic yards of concrete for the different plants.

Hauling charges are based on a fixed charge per day for gasoline locomotives, 900 lin.ft. of fixed tracks, and eight switches, to which is added the rental of cars, batch boxes, tracks, including passing tracks and switches, as their need increases in the length of the haul. The note to the caption of Fig. 2 shows the minimum and maximum charges respectively for each number of trains from three to six trains inclusive. The minimum simply includes charges for the fixed equipment, while the maximum includes charges for the total complement of cars, batch boxes, tracks, etc., for the maximum distances indicated for each haul.

Charges for concrete plant are based on a fixed charge per day for concrete mixer, derrick, tamping machine, steel forms, force pump and one-mile of 2-in. pipe line, to which is added the rental charges for additional pipe line and booster pumps, as the length of pavement increases and the need requires.

The unloading plant charge is a fixed quantity, comprising rental on the derrick, clamshell bucket, hoisting engine and boom-slewing engine, and varies only as the daily output of concrete varies.

To ascertain the plant charges per cubic yard of concrete, locate the vertical line on the chart, Fig. 2, representing the maximum distance of the end of the pavement from the material-receiving point, and follow this line until it intersects the line representing the estimated output per day for the plant charge required, and the value per cubic yard of concrete for the plant rental charge will be indicated by the nearest horizontal line to that intersection. The number of trains, as ascertained from Fig. 1, will be the key to the correct set of curves to use in ascertaining the hauling plant charge.

All plant charges, as indicated here, assume that enough equipment will be brought onto the work at the outset to take care of the maximum length of pavement. When the contractor has two jobs reasonably close together, these charges can be reduced by beginning one job at the point farthest from the material-receiving spur and the other at the nearest point, and transferring cars, track, etc., from the former to the latter as they are released. Where helper locomotives are used, a

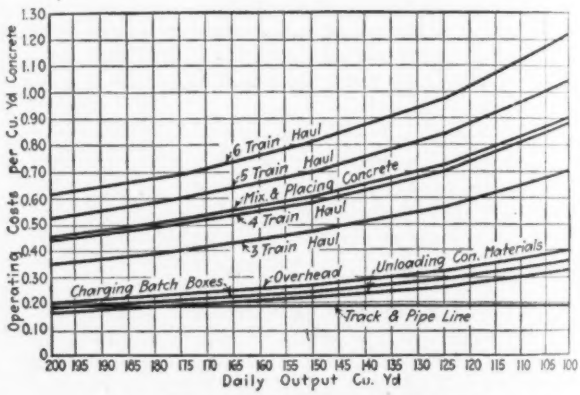


FIG. 3. OPERATING COSTS PER CUBIC YARD OF PAVEMENT

These diagrams are based on working force and wages computed as follows:

Charging Batch Boxes:	
1 foreman at $6	$6.00
6 laborers at $5	30.00
Total	$36.00
Mixing and Placing Concrete:	
1 foreman	$7.00
1 engineer	6.50
1 fireman	5.50
1 derrickman	5.50
4 spreaders at $5	20.00
1 tamper operator	6.00
2 foremen at $5.50	11.00
1 pumper	6.00
1 handyman	5.50
1 extra man	5.00
Total	$78.00
Fuel cost	9.00
Oil waste, packing, etc	2.00
Total	$90.00
Haulage per Train:	
1 engineer	6.00
1 brakeman	5.25
12 gal. gas at 30c	3.60
Oil, etc	2.00
Total	$16.85
Add to train service for hauling cost four trackmen at $5 or $20 per day.	
Field Overhead:	
1 superintendent	$12.50
1 clerk	7.50
2 watchmen at $6.25	12.50
Miscellaneous expenses	7.50
Total	$40.00
Unloading Material:	
1 engineer	$7.50
2 laborers at $5	10.00
1¼ tons coal at $8	14.00
Oil, etc	1.00
Total	$32.50
Laying and Taking up Track and Pipe Line:	
Laying and tak ng up track per mile	$250.00
Laying and taking up pipe per mile	150.00
Total	$400.00

Cost per mile applied against 2,100 cu.yd. of concrete.

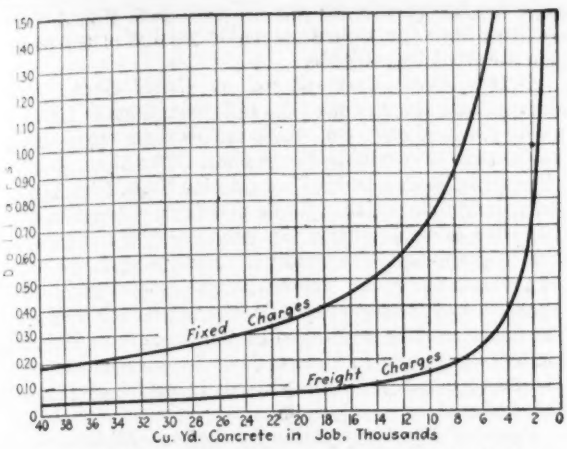


FIG. 4. FREIGHT ON PLANT AND FIXED CHARGES PER CUBIC YARD OF CONCRETE

A 24-In. Gage Outfit is Assumed with Common Labor Paid $5 per Day

Freight Charges

The basis of the curve is 1,500 cwt. at 10c. per hundred-weight. The 1,500 cwt. assumed will provide for a plant consisting of 5 hauling trains with 15 cars each and 10 mi. of track and pipe line. To arrive at the proper charge for freight multiply the cost per cubic yard taken from the curve by the percentage which the rate which applies bears to the 10c. rate platted and multiply this result by the percentage which the actual shipping weight of the outfit bears to the 1,500 cwt. platted in the curve. If freight both ways is to be charged against the job this final result should be doubled.

Fixed Charges

1 superintendent, 45 days at $12.50	$562.50
1 clerk, 45 days at $7.50	337.50
2 watchmen 45 days at $6.25	562.50
1 cement storage house	500.00
1 traveling bin	750.00
1 tool house	250.00
1 office and furniture	500.00
Small tools	1,250.00
Erect and dismantle plant	2,500.00
Total	$7,212.50

charge covering their rental value should be made in addition to the charges shown in the chart.

Operating Costs—In chart, Fig. 3, the different operating costs are divided under the heads: Charging batch boxes; mixing and placing concrete; hauling concrete materials; field overhead; unloading concrete materials, and laying and taking up track and pipe lines. The bases for these different operation costs are given in the note following the caption. A word here is necessary, however, to explain those operations for which the compass of the schedule is too limited to be self-explanatory.

In charging the batch boxes, the six laborers will place three sacks of cement in each batch box as it passes through the cement house. The train will then be spotted at the sand and stone bin, where four of the laborers will spout the sand and stone into the batch boxes. The other two laborers will remain in the cement-storage house and unload cement from cars into storage, and bale the empty sacks for return shipment to the cement mill. Cement will be taken from cars for the batch boxes whenever available and storage reserved for emergency. In the field overhead charge, the rate per day has been increased to cover lost time. In other words, the men included in this charge will receive wages whether the job is running or not, consequently their wages will be higher as applied against actual working days than would be indicated by the rate per day at which they are carried on the payroll. The track and pipe-laying charge presupposes that a mile of track and pipe will be laid and taken up for every mile of pavement laid.

To ascertain the cost of any of the different operations shown in the chart, trace the curve line, indicating the operation required, to its intersection with the vertical line indicating the estimated average output per day, and the cost per cubic yard of concrete will be indicated by the nearest horizontal line to that intersection. Should grades be encountered requiring helper locomotives, an addition should be made to the cost ascertained from the chart to cover the cost of wages of the trainmen and the cost of the fuel, etc., required in their operation.

Freight and Fixed Charges—On all contracts there are certain costs, such as freight on equipment; unloading, loading, assembling and dismantling plant; small tools, etc., that will generally be the same regardless of the size of the job. When the work is paid for on a unit-price basis, these costs must be pro-rated against the revenue producing work (in this case against the concrete pavement) and their cost per cubic yard of concrete will vary with the total yardage of concrete in the job. The curves in the chart, Fig. 4, show these costs per cubic yard of concrete for jobs containing up to 40,000 cu.yd. The basis of the charges is scheduled in the caption to the chart and is self-explanatory.

To ascertain the cost per cubic yard of concrete for the fixed charges, trace the curve line, representing the fixed charge, to its intersection with the vertical line, representing the total yardage of concrete in the job, and the nearest horizontal line to this intersection will indicate the cost per cubic yard of concrete. Of course, there will be some small variation, depending on the amount of track material, hauling equipment, etc., for

TABLE I. RENTAL CHARGES FOR CONCRETE PAVING EQUIPMENT, ASSUMING 200 EARNING DAYS AND 160 WORKING DAYS PER YEAR

Class of Equipment	Original Capital Cost	Annual Accrued Charges Per Cent	Annual Charges	Rental per Earning Day	Shop Repairs per Earning Day	Field Repairs per Earning Day	Daily Field Rental Charge	Total Rental per Earning Day	Total Rental per Working Day
3-ton gasoline locomotive	$1,875	20	$375	$1.88	$0.62	$0.75	$2.50	$3.25	$4.06
6-ton gasoline locomotive	3,200	20	640	3.20	1.05	1.25	4.25	5.50	6.88
8-ton steam locomotive	5,000	20	1,000	5.00	2.00	2.00	7.00	9.00	11.25
3-ton flat car brass journals	100	20	20	.10	.10	.10	.20	.30	.38
24 cu.ft. steel batch boxes	52	25	13	.07	.05	.08	.12	.20	.25
20 lb. rail for 1 mile track, incl. 300 ft. pass tr.	1,860	15	279	1.40	.35	.00	1.75	1.75	2.19
20-lb. rail for 900 lin.ft. fixed track	300	15	45	.23	.07	.00	.30	.30	.38
Steel ties and fastenings for 1 mi., 20 lb. tr., incl. pass tr.	1,200	15	180	.90	.35	.00	1.25	1.25	1.56
Steel ties and fastenings for 900 ft. fixed track	190	15	28	.14	.06	.00	.20	.20	.25
Switches complete for 20-lb. track	50	20	10	.05	.02	.00	.07	.07	.09
3-sack batch con. paving mixer	5,000	20	1,000	5.00	1.25	1.25	6.25	7.50	9.38
Derrick for con. paving mixer	500	20	100	.50	.15	.15	.65	.80	1.00
Caterpillar traction for paving mixer	750	20	150	.75	.25	.25	1.00	1.25	1.56
Power tamping machine	1,250	20	250	1.25	.25	.25	1.50	1.75	2.19
1500 lin.ft. steel forms	1,620	20	324	1.62	.38	.40	2.00	2.40	3.00
5-ton traveling derrick	2,500	20	500	2.50	.75	.75	3.25	4.00	5.00
1 cu.yd. clamshell bucket	1,050	20	210	1.05	.30	.30	1.35	1.65	2.06
Three-drum hoisting eng. steam	4,000	20	800	4.00	1.25	1.25	5.25	6.50	8.12
Skewing engine steam	700	20	140	.70	.20	.90	.20	1.10	1.38
Gasolene force pump	600	20	120	.60	.20	.20	.80	1.00	1.25
1-mile 2-in. galv. pipe line	1,200	15	180	.90	.30	1.20	.00	1.20	1.50

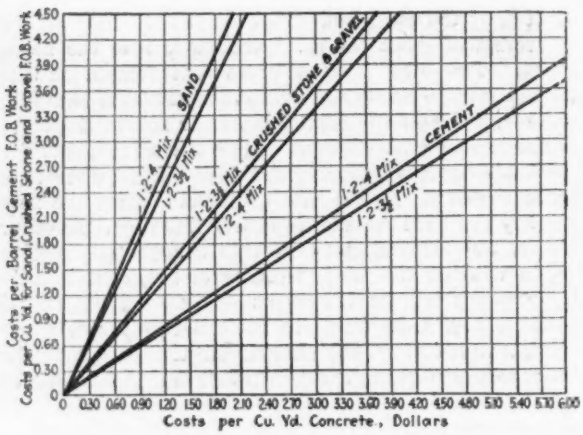

Costs per Barrel Cement F.O.B. Work
Costs per Cu. Yd. for Sand, Crushed Stone and Gravel F.O.B. Work
SAND
CRUSHED STONE & GRAVEL
CEMENT
1:2:4 Mix
1:2:3½ Mix
Costs per Cu. Yd. Concrete, Dollars

FIG 5. COST OF CONCRETE INGREDIENTS PER CUBIC YARD OF CONCRETE

Curves based on 45 per cent voids in sand and stone; one bag of cement considered 1 cu.ft.

the different work, but as this would only represent the cost of loading and unloading these items, the difference in unit cost is negligible. In ascertaining the charge to make for freight costs, proceed in the same manner as for fixed charges, but after ascertaining the result from the chart, multiply that quantity by the percentage the actual freight rate bears to the 10c. rate platted. Multiply the result by the percentage the actual shipping weight bears to the 15,000 cwt. platted. If freight is to be charged both ways, double this last amount.

TABLE II. ESTIMATE OF COST OF ASSUMED CONCRETE PAVEMENT

	Per Cu.Yd.
Chart Fig. 2—Plant Rental Costs:	
Hauling plant	$0.69
Concrete plant	.23
Unloading plant	.14
Total	$1.06
Chart Fig. 3—Operating Costs:	
Charging batch boxes	$0.29
Mixing and placing concrete	0.72
Hauling concrete materials	0.70
Field Overhead	0.32
Unloading concrete materials	0.26
Laying and removing track and pipe lines	0.19
Total	$2.48
Chart Fig. 4—Fixed Costs:	
Fixed charges	$0.35
Freight charges	.19
Total	$0.54
Chart Fig. 5—Concrete Material Cost:	
Broken stone	$2.15
Sand	.68
Cement	3.84
	$6.67
Grand total	$10.75
Liability insurance, 2.75% on $2.25	$0.06
Bond, 1½% on $12.58	.19
Total	$11.00
Add 4% for overhead and contingencies	.44
Total cost	$11.44
Add 10% for profit	1.14
Bidding price	$12.58

Cost of Concrete Ingredients—The chart, Fig. 5, shows the cost per cubic yard of concrete for the different ingredients for 1:2:4 and 1:2:3½ mixtures based on 45 per cent voids in the sand and stone and on a sack of cement being considered as containing 1 cu.ft. The horizontal lines in the chart indicate prices per cubic yard for the sand and stone and per barrel for the cement all f.o.b. cars at the job. The diagonal lines indicate the ingredients for the different mixtures, and the vertical lines the values per cubic yard of concrete for the different ingredients.

Curves Show Costs Based on Cubic Content—All curves show the values of the different items in terms of cubic yards of concrete, which makes them applicable to pavements of variable dimensions. The item showing the cost of laying and taking up pipe lines, Fig. 3, however, is the exception. While this item shows the costs in terms of cubic yards, the values shown in the chart are only applicable to roadways containing 2,100 cu.yd. of concrete per mile. For roadways containing different quantities of concrete per mile, the values obtained from the chart must be multiplied by the percentage the cubic contents per mile in the roadway in question bears to the 2,100 cu.yd. per mile platted, to arrive at this element of cost.

Value of Plant and Rates for Labor—All labor costs shown in the chart are based on common labor at $5 per day, and on the values of equipment, indicated in Table I. For the cost of pavements, where the values of labor and equipment are different from that indicated, the curves may still be used to advantage by ascertaining the labor and rental charges for the rates and values used in the curves, and adjusting the results to fit the actual conditions by applying to them the percentages the actual rates of labor and values of plant bear to those used in the curves.

Application of Curves—Taking a concrete case; assume that the cost of paving with concrete a road 10 mi. long with pavement 18 ft. wide, 6½ in. thick at the curb and 7½ in. thick at the crown is to be estimated. Assume the quantity of concrete as 2,100 cu.yd. per mile, the small excess to take care of waste and irregularities in the subgrade. The spur for receiving materials is located contiguous to the pavement and 5½ mi. from the farthest end. The ruling grade with loads is 2 per cent. Water for concrete and sprinkling is available from a storage reservoir near the receiving spur without charge. The concrete mixture is to be 1:2:4, machine tamped. Freight on equipment is charged both ways and the freight rate is 20c. per hundred. The cost of crushed stone is $2.40 per cu.yd., sand $1.50 per cu.yd. and cement $2.55 per barrel net, all f.o.b. cars at the material-receiving spur. Assume the cost of common labor at $5 per day and the daily output as 125 cu.yd. of concrete. The total quantity of concrete to be placed is 21,000 cu.yd. The shipping weight of the plant is 10,000 cwt. Fig. 1 shows that eleven loaded cars can be hauled up the 2 per cent grade and that four hauling trains are required for the maximum haul of 5½ mi. Extracting the values of the different cost items from the charts, and tabulating them, we have the results given in Table II.

Reducing the bid to a price per square yard of pavement and assuming that one cubic yard will cover 5 sq.yd., we have $12.58 divided by 5 equals $2.52 per sq.yd. of pavement as the bidding price. Theoretically, 1 cu.yd. will cover a trifle more than 5 sq.yd., but practically there will be enough low spots in the subgrade and other waste to take up the small margin allowed. The above costs and prices only include the concrete masonry; where reinforcing steel, grading and other items are called for and included in the price bid for concrete pavement, their costs should be figured independently and the bid increased to cover the costs of, and the profits on, these items.

Developments in New York State Highway Maintenance

Two-Wheeled Carts for Cold Patching—Equipment Storehouses Provided—Army Trucks Remodeled for Road Work

MAINTENANCE equipment employed this year by the New York State Highway Department includes several devices in addition to those previously used, and described in *Engineering News-Record* of Nov. 28, 1918, p. 981. A beginning has been made toward a policy of establishing equipment storehouses of permanent construction and designed for their purpose. In particular, conspicuous success has been attained in converting fixed-body Army motor trucks into vehicles adapted to special maintenance operations.

For maintaining bituminous-macadam surfaces, the two-wheeled material carrier shown in Figs. 1 and 2 is reported to be especially useful. This cart is used, with the small concrete mixer, for hauling cold-patch

FIG. 1. MIXING COLD PATCH AT A CENTRAL POINT

bituminous mixtures for repairing small holes. The advantages of the device are that it is low so that the mixer can dump directly into it, and that it is easily propelled by two men. Since this kind of repair work generally is in small patches at varying distances apart, another advantage is that instead of delivering small amounts of material along the road adjacent to the patches it is feasible to dump materials and mix at a central point and to haul with the cart in each direction.

Cold patching has been found to be very successful and is quite extensively used. It is now possible to get

FIG. 2. PATCHING HOLES AT SOME DISTANCE FROM MIXER

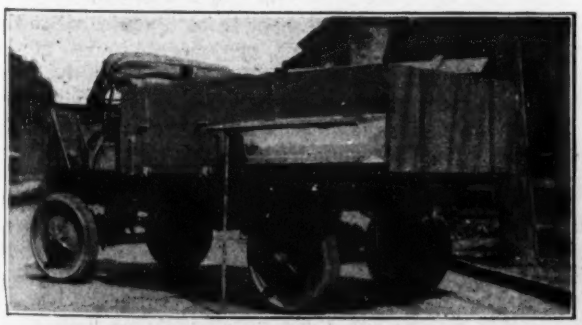
several different brands of asphaltic emulsions and cut-back preparations. The small mixer shown in the illustration has been found particularly adapted to mixing these preparations without causing separation. Cold-patch material is also being used by the department for quite extensive resurfacing and widening. Several roads were completely resurfaced by this method during 1918, when bituminous materials were scarce, and, during the present year, Division No. 2 is doing extensive widening in Saratoga County.

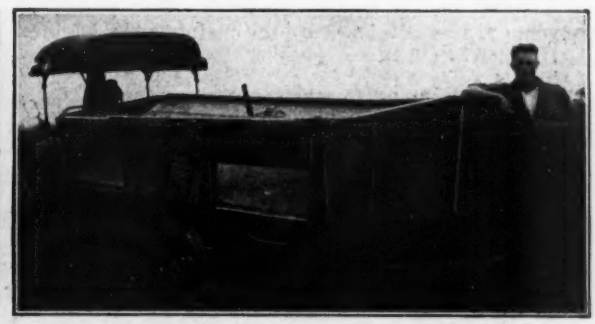
The method followed in widening is to dig trenches at the edges and lay a foundation course of field or crushed stone, 6 to 12 in. in depth, upon which is placed a 2- to 3-in. course of broken stone mixed with cold-patch bituminous material. It is found possible to make a uniform joint and surface of even appearance, without giving the road a surface treatment, as is customary. All new widths are made 18 feet.

Converted Army Motor Trucks

It has been a problem in many cases to determine what use can best be made of the motor trucks from the United States Government which highway departments throughout the country are receiving in large consignments. Practically all of these trucks are of the fixed-box type, while the requirements of highway work, generally speaking, call for dump boxes.

To utilize the trucks, it has been found necessary in many cases practically to remodel them by placing new dump boxes and dumping apparatus. Fig. 3 shows one of these trucks, of the Nash-Quad type, with ammunition box, which has been remodeled by building a





FIGS. 3 AND 4. ARMY TRUCKS REMODELED FOR STATE HIGHWAY MAINTENANCE WORK
Fig. 3—Truck with fixed box divided into compartments. Fig. 4—Truck with collapsible bottom for use as either a side-dump or straight box type

special fixed box for dumping stone and sand in small piles for patching and covering purposes. It was found that it would be too expensive to cut down and remodel the old boxes, so a new compartment box was built, each of the four compartments holding ¼ cu.yd. of stone. Upon being filled, the truck proceeds to the road and dumps the ¼-yd. batches at points where they are required for patching or for applying as covering stone for surface treatments. The box is built with a peaked bottom, and it is only necessary to open the trap-door fastenings and allow the material to slide out at the side of the road.

The entire box was built of wood instead of iron, as was the original ammunition box. It is arranged with staked sides so that the sides and peaked bottom can be removed in a few minutes by two men, leaving an ordinary platform truck for hauling barreled bituminous materials or other bulky packages or apparatus. The cost of the change from the old to the new box is stated to have been $250. This change was made by the maintenance engineer of Division No. 4 at Utica, N. Y. Another remodeled truck without separated compartments is shown in Fig. 4. It is claimed that this arrangement is much lighter than the one just described. The bottom consists merely of a frame upon which the two sections of the peaked bottom rest, and, when it is desired to utilize it as a platform truck the ridge simply collapses so as to lie flat on the truck. This arrangement also has the advantage that the peaked bottom is always with the truck, and the change can be made in a few minutes from one type to the other. With the arrangement described first, the bottom has to be removed entirely from the truck when it is being used as a platform truck. This second arrangement was developed by the maintenance engineer of Division No. 6 at Syracuse, N. Y.

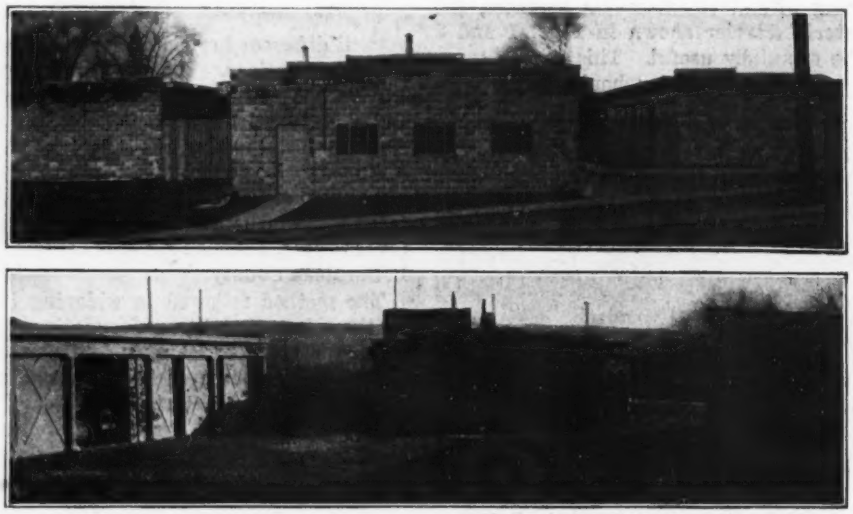


FIG. 5. EXTERIOR AND INTERIOR VIEWS OF PERMANENT MAINTENANCE STORAGE HOUSE

Permanent Equipment Storehouses

Heretofore the maintenance apparatus of the highway department has been cared for in a more or less haphazard manner. It has been the custom to rent several barns in each of the several counties which make up a division and store the equipment in the neighborhood where it is used in the summer. This has led to inefficiency in the care of machines, besides entailing extra expense due to superintendence and the hiring of a large amount of space which could not be utilized, as it was seldom that there was sufficient equipment in one locality to fill the quarters provided.

To overcome these defects, Division No. 2, of which Harvey O. Schemerhorn is division engineer, built a central storehouse at Waterford, N. Y. The substantial construction of the buildings is shown by Fig. 5. The arrangement consists of a repair shop at the center and front of the yard, with long storage sheds at either side. The buildings are constructed of cement blocks.

The repair and machine shop is used for overhauling trucks and other machinery. It contains a set of tools for completely overhauling and repairing all the machinery used by the department. Hoists are provided for removing and transferring bodies from one truck to another, and lathes and other tools for repairing broken parts. Stalls are also provided for the storage of cement, paint, bituminous and other materials.

One great advantage of this centralized storage is that the truck operators are kept on during the winter for the purpose of making repairs to their trucks, whereas it has been necessary heretofore to lay them off. It is understood that other divisions in the state are to construct similar central storehouses as soon as the necessary funds are made available. The views of the sheds show the open sliding doors with motor trucks, steam rollers, etc., stored for the winter.

Maintenance repair and reconstruction of the improved system of state and county highways in New York State is under the general supervision of Irving V. A. Huie, second deputy commissioner of highways.

Circular Meter Housing Cheaper Than Square

Circular meter housings instead of the square type have been tried out by the St. Louis Water Department, and found to be much cheaper in cost, according to the annual report of L. Chivvis, engineer in charge of the distribution section, to E. E. Wall, water commissioner. The meter is raised on two pipe uprights to within 18 in. of the surface, and is protected against frost by a double cover. Two hundred circular covers were purchased at a cost of $2.16 each, as compared with $14.90 for the old, square type, a set of steel forms for conical concrete housings was bought, and a score or more of the new installations were put in.

The round box takes up less room and requires less excavation, and is easier to handle. Its sole weakness is that it is not adaptable to granitoid sidewalks without running the risk of tearing out the granitoid to repair leaks on the supply pipe below the meter.

How House Building Costs Have Increased Since 1913

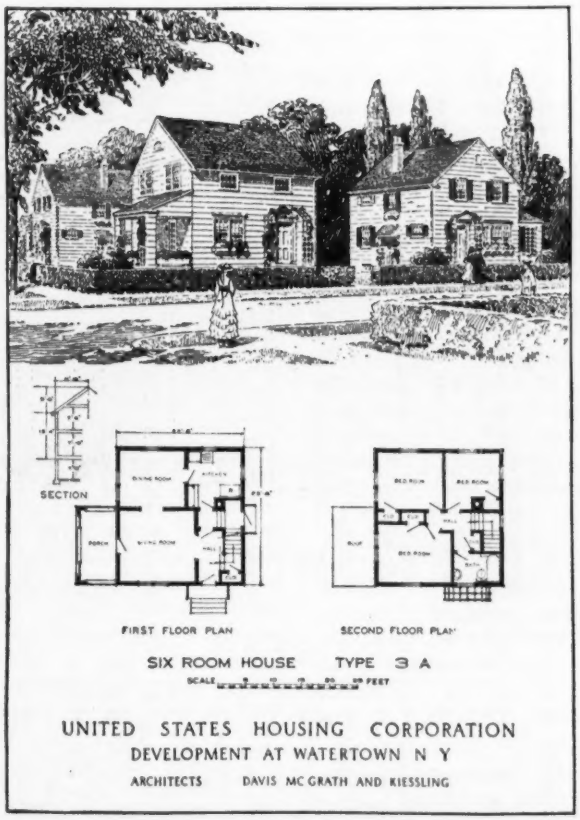
Figures Compiled by United States Housing Corporation Show That Small House Built for $4,117 in 1913 Would Have Cost $6,833 in Spring of 1919

By LeRoy K. Sherman
President, United States Housing Corporation, Washington, D. C.

BUILDING costs have advanced materially since before the war. That is an obvious observation, but exact figures based on close estimates of quantities and prices are rarely published. A useful purpose will doubtless be served by the compilation of such comparative figures recently made by the United States Housing Corporation for a small residence of the type which can well be used in an industrial housing development.

The corporation has completed the construction of some 6,000 houses and 64 dormitories. These houses are located in twenty-five different places in the United States, from Vallejo, Cal., to Bath, Maine. Most of this work was done during the period of the war emergency and at a time when efficiency meant speed rather than cheapness, so that the actual cost of these houses was greater than would be the case under normal conditions. However, with the experience of the builders and estimating and purchasing departments of the Corporation, it has been possible to compile comparative estimates under normal conditions.

For the purpose of comparing the cost of dwelling house construction there was selected a six-room frame dwelling house shown in the accompanying illustration. This house is a very common and popular type of dwelling and is described on p. 375, of vol. II of the Report of the United States Housing Corporation. It is two stories with basement, having the living room, dining room and kitchen on the first floor and three rooms with bath and toilet on the second floor. The outside dimensions of the floor plan are 22 ft. 8 in. by 23 ft. 8 in. The cubical contents is 14,900 cu.ft.


SECTION
FIRST FLOOR PLAN
SECOND FLOOR PLAN
SIX ROOM HOUSE TYPE 3 A
UNITED STATES HOUSING CORPORATION
DEVELOPMENT AT WATERTOWN N Y
ARCHITECTS DAVIS MC GRATH AND KIESSLING

VIEW AND FLOOR PLAN OF SIX-ROOM HOUSE ON WHICH COST ESTIMATES ARE MADE

This house has a monolithic concrete substructure wall 8 in. thick, from footings to the bottom of first-story floor joists, and is plastered from grade to the top of wall with white cement plaster. The cellar is entirely paved with a 4-in. concrete floor. Subsoil drainage under cellar floor consists of 4-in. broken stone and a line of 4 in. diameter tile drain pipe placed around the inside face of footings. The walls of superstructure, both interior and exterior, are of 2 x 4 in. studs; sheathed, papered and weather-boarded on exterior and lathed and plastered, three coats—scratch, brown and hard white coat—on the interior walls. The roof is sheathed, papered and covered with a good quality slate. All flashings and counter-flashings of galvanized iron are painted with two coats of metallic paint.

Wood floors are doubled, with a layer of deadening felt between. The first and second floors are trimmed throughout with baseboard having shoe and cap moldings; all window and door openings are trimmed both sides, windows have stools and aprons and door openings have hardwood thresholds. All rooms, excepting kitchen, bath and closets have picture mold. A kitchen dresser is provided, and a medicine cabinet with mirror is placed in bathroom.

The woodwork throughout is B grade or better yellow pine. All exterior woodwork is painted three coats of lead and oil paint, and, with the exception of kitchen and bathroom, all interior woodwork is given two coats of varnish stain. The woodwork of kitchen is painted two coats of lead and oil paint and the bathroom woodwork three coats of enamel. All wood floors are given two coats of boiled linseed oil. All interior ceilings and walls, excepting walls of kitchen and bath, are painted two coats of cold-water paint. Walls of kitchen and bath are sized and painted two coats of oil paint.

A complete hot-air system is provided for the heating with a "Liberty Heater," a combination furnace and gas heater, complete with stove pipe, damper, damper regulator, check damper and a complete set of firing tools. The furnace has been tapped for the installation of hot water coils. All pipes and stacks are covered with 16-lb. paper asbestos. All registers are cast iron, black japanned, lattice design with iron borders.

The plumbing system is modern. Soils and vertical stacks are of "medium" cast iron, with all joints calked with oakum and leaded. Cleanout Y's with brass screw plugs are placed at foot of vertical risers. Floor drains have been provided in cellar floor and in the floor of side entry for refrigerator. Fixtures are supplied with both hot and cold water, hot water being supplied from a 24-gal. boiler connected to kitchen range, which is also

TABLE I. COMPARATIVE COST OF MODERN SIX-ROOM FRAME HOUSE FOR 1913 AND 1919

Unit prices used for each period were current in Boston, Mass. Unit prices for 1919 for both labor material were effective in May

	Items	1913							Remarks	1919					Remarks
		Material Required		Labor Cost		Material Cost		Labor and Material Total		Per cent increase	Labor Cost	Per cent increase	Material Cost	Labor and Material Total	
		Unit	Qnty.	Unit	Cost	Unit	Cost								
1	Excavations (general)	Cu.yd.	127	$0.50	$63.50		None	$63.50		100	$127.00		None	$127.00	Building laborers' wages increased from 25c. to 50c. per hour
2	Excavations (trench)	Cu.yd.	6	.75	4.50		None	4.50		100	9.00		None	9.00	Building laborers' wages increased from 25c. to 50c. per hour.
3	Backfill and grading	Cu.yd.	130	.17	22.10		None	22.10		100	44.20		None	44.20	Building laborers' wages increased from 25c. to 50c. per hour.
4	Cinderfill under cellar floor	Cu.yd.	6	.40	2.40	1.00	$6.00	8.40	50c. for cinders plus 50c. for hauling	100	4.80	50	$9.00	13.80	Building laborers' wages increased as above. Material increased for hauling only.
5	Concrete foundation walls	Cu.yd.	23	1.25	28.75	3.50	80.50	109.25		100	57.50	100	161.00	218.50	Building laborers' wages increased as above. Cement, sand and stone up to 100%.
6	Forms for foundation walls	Sq.ft.	1,704	.035	58.64	.030	51.12	109.76		71	100.27	67	85.37	185.64	Carpenters' wages increased from 50c. to 75c—50%. Building laborers as above. Lumber up 67%.
7	Concrete floor in cellar	Cu.yd.	513 4	.02 1.50	10.26 7.13	.03 4.00	15.39 19.00	51.78	Top figures for finished top coat in sq.ft.	20 100	12.31 14.26	100	30.78 38.00	95.35	Cement finishers and finishers' helpers' wages increased from .625–75; .375–.50; material as Item 5.
8	Waterproof painting	Sq.ft.	565	.005	2.83	.015	8.48	11.31		100	5.66	50	12.72	18.38	Painting done by building laborers. Wages increased as above. Material up to 50%.
9	Drainage under cellar floor	Lin.ft.	93	.05	4.65	.05	4.65	9.30	Cinders included in cinder fill.	100	9.30	25	5.81	15.11	Building laborers' wages up to 100%. Material 25%.
10	Flue lining, 9-in. diameter	Lin.ft.	28	.05	1.40	.25	7.00	8.40		40	1.96	25	8.75	10.71	Bricklayers' waged increased from .625 to .875. Material up 25%.
					30.00		20.00			71	51.30	67	33.40		Plasterers' wages increased from .625 to .875. Plasterers' laborers, from 30 to 50. Material as Item 5.
11	Plastering (interior)	Sq.yd.	432	.20	86.40	.11	47.52	183.92	Top figures for scaffold	46	126.14	100	95.04	305.88	
12	Lathing (wood lath)	Sq.yd.	432	.05	21.60	.06	25.92	47.52		44	31.14	80	46.66	77.80	Lathers' wages increased from .565 to 81c. Lath up 80%.
13	Corner beads	Lin.ft.	82	.02	1.64	.03	2.46	4.10		44	2.36	67	4.11	6.47	Lathers' wages as above. Material up to 67%.
14	Plastering (exterior)	Sq.yd.	21	.33	6.93	.30	6.30	13.23		44	9.98	100	12.60	22.58	Plasterers and plasterers' laborers wages. Increased as above. Material as in Item 5.
15	Plaster board	Sq.ft.	100	.02	2.00	.05	5.00	7.00		50	3.00	67	8.35	11.35	Carpenters' wages increased as above. Material up 67%.
16	Miscellaneous iron, rough hdwre.						35.00	35.00				100	70.00	70.00	Material only: labor included in items. Material up 100%.
17	Lumber and carpentry				226.87		391.47	618.34		67	378.87	67	653.75	1,032.62	Carpenters and building laborers' wages increased as above. Lumber up 67%.
18	Exterior millwork				158.43		177.91	336.34		60	253.49	75	311.34	564.83	Carpenters and building laborers' wages as above. Lumber up 75%.
19	Interior millwork				146.28		210.81	357.09		60	234.05	75	368.92	602.97	Carpenters and building laborers' wages as above. Fin. lumber up to 75%.
20	Champion clothes dryer No. 2														
21	Roofing	100 sq.ft.	10	2.00	20.00	10.00	100.00	120.00		45	29.00	25	125.00	154.00	Slate roofers' wages increased 40%. Laborers' wage up as above; .625-.875; 25c. to 50c.
22	Sheet metal				12.00		24.00	36.00		50	18.00	100	48.00	66.00	Sheet metal workers' wages increased 50%; from 50 to 75c. per hour.
							25.00						25.00		Painters' wages increased 50% from 50 to 75c. per hr. Linseed oil up 400%. W. lead 100%.
23	Painting				93.37		50.15	168.52	Top figures for ladders and scaffold	50	140.06	300	200.60	365.66	
24	Plumbing				130.00		195.00	325.00	Including 20% for contractors' overhead, expenses and profit	75	227.50		264.50	492.00	Plumbers' wages increased from 50c. to 75c. per hour.
25	Finished hardware						37.00	37.00				75	64.75	64.75	Material only. Labor included in millwork. Material up to 75%.
26	Electrical work	Outlets	11		18.00		42.00	60.00	Including fixtures	36	24.48		54.00	78.48	Inside wiremen and I. W. fixture hangers. Wages increased 36% and 50%.
27	Heating				37.00		148.00	185.00	Including 20% for contractors' overhead, expenses and profit	50	55.50	50	222.00	277.50	Sheet metal workers' wages increased as above.
	Total cost of labor and material				$1,196.68		$1,735.68		Labor increase	65	$1,971.13		$2,959.45		71% Material increase
	Grand total							$2,932.36						$4,930.58	68% Total increase labor and mat'l

TABLE Ia. COSTS OF ALTERNATE MATERIALS AS APPLIED TO FIGURES IN TABLE I.

	Items	1913 Material Required Unit	1913 Material Required Qnty.	1913 Labor Cost Unit	1913 Labor Cost Cost	1913 Material Cost Unit	1913 Material Cost Cost	1913 Labor and Material Total	Remarks	1919 Per cent increase	1919 Labor Cost	1919 Per cent increase	1919 Material Cost	1919 Labor and Material Total	Remarks
	Alternates														Deductions and Additions for Alternates
1	Asphalt (ready) roofing	100 sq.ft.	10	.50	$5.00	3.00	$30.00	$35.00		75	$8.75	50	$45.00	$53.75	$100.25 Deduct for asphalt roofing
2	Wood shingles	100 sq.ft.	10	1.90	19.00	4.00	40.00	59.00		67	31.75	100	80.00	111.75	72.25 Deduct for wood shingles
3	Rubble masonry foundation walls	Cu.yd.	30	3.50	105.00	3.50	105.00	210.00		40	147.00	50	157.50	304.50	99.64 Deduct for rubble found'n
	Stucco on exterior walls	Sq.yd.	176	.69	121.44	.80	140.80	262.24	Including metal lath	46	177.30	100	281.60	458.90	323.49 Add for stucco exterior
	Terra cotta block foundation walls	Cu.ft.	833	.15	124.95	.15	124.95	249.90		40	174.93	100	249.90	424.83	20.69 Add for T.C. block found'n

provided. With the exception of water closet and flushing tank, fixtures are of enameled iron. The two fixtures named are of porcelain.

The electrical work is B-X work, as per requirements of the National Board of Fire Underwriters. The fixtures consist of 1 light ceiling fixture, cast canopy 5 in. in diameter with translucent glass shade, for kitchen, first and second story halls, and bedrooms; dining and living rooms have 1 and 2 light fixtures with cast canopies and chains supporting, 12-in. opal glass bowl for semi-direct lighting in dining room and each of the two lights of living room fixtures. The fixtures throughout are of metal-brush-brass finish.

This house was built between October, 1918, and May, 1919, at Watertown, N. Y., by the U. S. Housing Corporation in connection with 114 other houses in the same vicinity, for the sum of $3,908. On the accompanying tabulation (Table I), the estimated cost of this house, if built in 1913, would have been $2,932, exclusive of overhead and profit excepting as noted. On the same tabulation, the estimated cost of this house constructed today (that is, on units as in force in May, 1919) would be $4,930, exclusive of contractor's profit and overhead, excepting as noted. The estimates show an increase in cost of building from 1913 to 1919 of 68 per cent, of which the labor increase is 65 per cent and the increase for materials is 71 per cent. The prevailing union scales of wages for laborers and mechanics in the building trades for the City of Boston in 1913 and 1919 were used in making this comparison. They were selected as they happened to represent to a fair degree the average increase in building trades wages.

Table II is an analysis of the unit prices for labor as given on the estimate sheets. How this table was used in the compilation may be explained by the following example:

Item 6, Labor, cost per hour 1913:

Carpenters	400 sq.ft. — 8 hrs. @ 0.50	$4.00 ÷ 400 sq.ft.	0.01 making forms
	400 sq.ft. — 8 hrs. @ 0.50	$4.00 ÷ 400 sq.ft.	0.01 placing and bracing
Laborers	400 sq.ft. — 8 hrs. @ 0.25	$2.00 ÷ 400 sq.ft.	0.005 placing and bracing
Laborers	400 sq.ft. —16 hrs. @ 0.25	$4.00 ÷ 400 sq.ft.	0.01 wreck, clean and pile
	40 hrs.		0.035 unit cost

400 sq.ft. ÷ 40 hrs., 10 sq.ft. per hr. 10 sq.ft. x 0.035 = 0.35 labor rate per hour
Labor cost 1913 —$14.00 10 ÷ 14 = 0.71 per cent labor increase for 1919
Labor cost 1919 —$24.00

Cost of Materials and Wages

The unit prices used in the estimate for materials were obtained from the Department of Labor, Bureau of Labor Statistics, and from the published records in the various trade journals The fluctuation of prices of building materials were shown in the diagram reprinted in the *Engineering News-Record*, Oct. 30-Nov. 6, 1919, p. 799. The total percentage increase in cost of materials for the six room houses, which we have used for illustration, is 71 per cent.

The rate of wages per hour for the various building trades in 1913 and 1919 were obtained from a bulletin of the Bureau of Labor Statistics with the exception of 1919. The rates for that year are those contained in the report of the proceedings of the third annual convention of the American Federation of Labor under date of June 4-7, 1919. The increase in the wage scale of the various trades in eight cities of the United States is shown in *Engineering News-Record*, Oct 30-Nov. 6, 1919, p. 788. The percentage of increase in wages in 1919 over 1913 varies in the trades used in our estimate from 36 per cent to 100 per cent. The total percentage increase in the cost of labor in the six-room frame house, which we have used for illustration is 65 per cent. The total percentage of increase for both labor and material is 68 per cent.

It appears that there has been a material increase in the cost of building labor in 1919 over 1918, but this increase has only followed the corresponding increase in cost of building materials and other commodities. The cost of both building labor and material now appear fairly comparable with other increases in the cost of living.

Hollow Tile and Brick Houses

In addition to the estimate for the six-room frame house, estimates have been prepared for a similar house built of hollow tile and also one of brick. The comparison of the three is as follows:

COMPARISON OF COST OF SIX-ROOM DWELLING HOUSE

Type of House	1913	1919	Per Cent of Increase
Frame house	$2,932.36	$4,930.58	68
Hollow tile stuccoed	3,362.65	5,665.18	68
Brick	3,546.34	6,038.73	70

In the comparison of estimated costs as of 1913 and 1919, the same amount of materials and the same rates of output of labor are used in each case. The rates of output of building labor are, of course, subject to wide fluctuations. The rates assumed have been compiled and checked by the Estimating Division of the United States Housing Corporation and by builders of practical experience. The efficiency of labor in the comparison presented is taken as being the same in 1919 as in 1913. With the exception of a period in the spring of 1919, many building contractors maintain that the efficiency of building labor is not as high now as it was in 1913.

In compiling these tables the cost of labor and material were figured out for each item for the house built as of 1913. The 1919 costs were arrived at by applying the percentage of increase in labor and material (which was derived from the diagram showing fluctuations in cost of labor and material) to the 1913 figures. It should be borne in mind that this is an estimate based on average prices and average work under union labor. There is a wide variation in the cost of labor and the cost of materials in different parts of the country and this same house built under different conditions from those assumed here may easily vary in cost $500 or more.

The foregoing estimates do not include public utilities, contractor's profit and overhead or architect's fee.

From the report of the "Economics of the Construction Industry" by the United States Department of Labor, as well as from the Real Estate Division of the United States Housing Corporation, the indications are that there has been little increase in the value of land occupied by the ordinary dwelling house. For the purpose of further comparison, the total cost of the frame house with land, appurtenances and overhead, we will assume the following:

Cost of land ($1,000 per acre—7 lots per acre)	$143.00
Cost of public utilities per lot	400.00
Contractor's profit and overhead, per cent	15
Architect's fee—plans and supervision, per cent	6

Based upon the foregoing the comparison of the total cost of erection of houses in 1913 and 1919 is as follows:

SIX-ROOM FRAME HOUSE

	1913?	1919
Net cost of building	$2,932.36	$4,930.58
Cost of land at $1,000 per acre	143.00	143.00
Cost of public utilities	400.00	680.00
Contractor's profit and overhead, 15 per cent	439.85	739.59
Architect's fee—plans and supervision, 6 per cent	202.33	340.21
	$4,117.54	$6,833.38

Increase of 66 per cent.

The housing shortage today is almost universal. It exists not only in the cities of the United States but in almost every other country. The housing shortage in this country due to war activities and the increased cost of construction has been estimated at 1,000,000.

The market value of a house differs from most commodities. In most commodities the consumption closely approximates the supply and the selling value follows and corresponds with the increase in cost. The selling value of dwelling houses as a commodity is governed largely by rentals which the house will bring. By far the greater part of the house rentals come, of course, from houses built during pre-war costs. The rent of these houses, as heretofore stated, has increased in general not over 20 per cent. This represents an increased income to the owner without an increased expenditure of capital.

An entirely different situation exists with respect to the owner renting a house built in 1919. A 20 per cent increase in rents based on 1913 costs will not bring the owner of a new building a rental sufficient to warrant him investing his money in dwellings for rental purposes. The new owner has to compete with the numerous owners of property built in pre-war times.

Of course, there are many cities where the housing shortage is so acute that new buildings are built and readily rented or sold at prices considerably in excess of the 1919 estimates which we have presented. Unquestionably, as the housing shortage becomes more acute and as the older houses become obsolete and go out of the market, all rentals and selling values of property will tend to approach the prices based on the cost of the new house.

During this transition period the wits of people have been sharpened in an effort to meet the problem. They are using some lessons learned from the Government's housing experience during the war and they are supplying construction and financial methods which will reduce the cost of the building to the occupants. The housing problem during the transition period is being solved by more efficient methods of construction and financing so that economies in production will tend to reduce the cost of new dwellings as a compromise to meet the rising values of the older property.

A large part of the new dwelling construction now being undertaken is handled by housing companies. The membership of these companies consists largely of pub-

TABLE II. ANALYSIS OF UNIT PRICES FOR LABOR, 1913–1919
Prepared by United States Housing Corporation, Washington, D. C.

No.	Item	Unit Quantity	Unit Cost	Quantity per Hour	1913 Labor Rate per Hour	1919 Labor Rate per Hour	Per Cent Increase
1	Excavation (general)	Cu.yd.	0.50	0.50	0.25	0.50	100
2	Excavation (trench)	Cu.yd.	0.75	0.333	0.25	0.50	100
3	Backfill and grading	Cu.yd.	0.17	1.47	0.25	0.50	100
4	Cinder fill, no cement	Cu.yd.	0.40	0.625	0.25	0.50	100
5	Plain concrete	Cu.yd.	1.25	0.20	0.25	0.50	100
6	Forms for concrete	Sq.ft.	0.035	10.00	0.35 { 0.50 / 0.25 }	0.75 / 0.50	71
	Laborer's time ½ carpenters						
7	Concrete floor, cellar	Cu.yd.	1.50	0.167	0.25	0.50	100
	Top dressing	Sq.ft.	0.02	31.25	0.625	0.75	20
8	Waterproof painting	Sq.ft.	0.005	50.00	0.25	0.50	100
9	Drainage cellar floor	Cu.ft.	0.05	5.00	0.25	0.50	100
10	Flue lining	Lin.ft.	0.05	12.50	0.625	0.875	40
11	Plastering (interior)	Sq.yd.	0.18	2.666	0.48 { 0.625 / 0.315 }	0.875 / 0.50	46
	Laborer's time ½ plasterers						
12	Lathing	Sq.yd.	0.05	11.3	0.565	0.81	44
13	Corner beads	Lin.ft.	0.02	28.3	0.565	0.81	44
14	Plastering (exterior)	Sq.yd.	0.313	1.693	0.53 { 0.625 / 0.315 }	0.875 / 0.50	58
	Laborer's time ½ plasterers						
15	Plaster board	.....	0.02	25.00	0.50	0.75	50
17	Lumber and carpentry	1000 b.m.	17.14	0.0219	0.375 { 0.50 / 0.25 }	0.75 / 0.50	67
	Laborer's time equal carpenters						
18	Exterior millwork Laborer's time ½ carpenters	Lump sum			0.417 { 0.50 / 0.25 }	0.75 / 0.50	60
19	Interior millwork Laborer's time ½ carpenters	Lump sum					
21	Roofing Laborer's time ½ roofers	100 sq.ft.	2.00	2.75	0.55 { 0.625 / 0.25 }	0.875 / 0.50	45
22	Sheet metal	Lump sum	.....	.....	0.50	0.75	50
23	Painting	Lump sum	100.00	0.50	0.50	0.75	50
24	Plumbing	Lump sum	.....	.....	0.50	0.875	75
26	Electrical work	Lump sum	.....	.....	0.55	0.75	36
27	Heating	Lump sum	.....	.....	0.50	0.75	50

lic spirited citizens, who are content to finance the construction of dwellings at a modest return on their investment and they realize the incidental value which will revert to their city and their local industries by adequate housing facilities. The economies which are obtained by these housing companies are accomplished by a reduction in the overhead cost which was mentioned in the estimate of the total cost of the dwelling to the occupant. These economies effected by a comprehensive plan, are as follows:

Reduction per house in the contractor's percentage or profits and the architect's and superintendent's fees by the construction of a hundred or more houses at one time under one contract.

The reduced cost of materials by purchase in carload lots for wholesale building.

The more efficient utilization of highly subdivided and specialized labor by the ability to install a more efficient construction organization where a number of houses are built at one time.

The use of standards and uniform sizes in designs which do not, however, make the houses appear to be standardized.

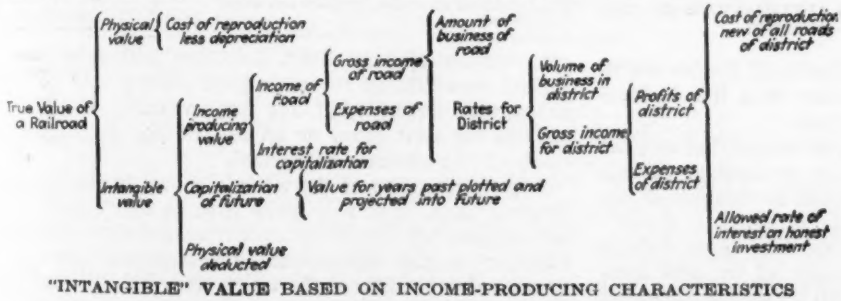
The improvements in arrangement of utilities and conveniences in the house, as well as the artistic arrangement of the buildings, drives, trees and planting, so that the added attractiveness of the house will invite the occupant in spite of an increased rental or cost.

Elements of Value Graphically Shown

By Orlin R. Morse
Pilot Engineer, Missouri, Kansas & Texas R.R.
Formerly Senior Engineer, Bureau of Valuation, I. C. C.

THE outline shown herewith is intended as a definite basis for argument, drawing a distinction between physical and intangible value and analyzing the elements of the latter. The key to such a solution is the assumption that the owners of the railroads should receive a fair rate of return on money invested.

A district having uniform transportation conditions, such as cost of construction, volume of business and cost of operation, is considered as a unit, the income


True Value of a Railroad
Physical value
Cost of reproduction less depreciation
Intangible value
Income producing value
Income of road
Gross income of road
Expenses of road
Interest rate for capitalization
Capitalization of future
Physical value deducted
Value for years past plotted and projected into future
Amount of business of road
Rates for District
Volume of business in district
Gross income for district
Profits of district
Expenses of district
Cost of reproduction new of all roads of district
Allowed rate of interest on honest investment

"INTANGIBLE" VALUE BASED ON INCOME-PRODUCING CHARACTERISTICS

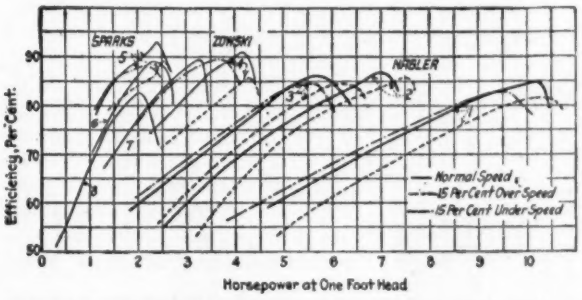
within the district paying for the investment. Should each road retain all of its earnings, the intangible value will accordingly be increased or diminished. For the small roads, a terminal charge plus a mileage charge for the haul would bring more income.

In the analysis shown above the physical value of the individual railroad does not affect the true value. Intangible value as here outlined agrees with expert testimony given in the Kansas City Southern hearing, in which the railroad based claim for intangible value on income-producing qualities.

New Hydro-Turbine Runner Shows Epochal Development

Waterwheel Described in Paper by Designer Gives 140 Per Cent More Power and 50 Per Cent Greater Speed Than Previous Types

AFTER a half-century of hydraulic-turbine development when the most rapid advance, beginning in the 90's, was based on the mixed-flow reaction and the impulse type of runner, comes the startling announcement in a paper read before the American Society of Mechanical Engineers, Dec. 4, by the designer, Forrest Nagler, of a very simple, axial-flow type of runner, testing 140 per cent more power and a 50 per cent greater characteristic speed than any type previously available. In comparison with other types the new runner is claimed to be especially efficient in turbines operating under low head.



POWER-EFFICIENCY CURVES FOR WHEELS HAVING A NORMAL SPEED OF 50 R.P.M.

Mr. Nagler's paper describing and comparing his runner with others was based on a series of Holyoke tests and on various actual installations by the Allis-Chalmers Manufacturing Co. For comparison he used Professor Zowski's mixed-flow runner as the highest standard of previous development. Professor Zowski described his runner and the result of its Holyoke tests in an article in *Engineering Record*, Dec. 26, 1914, p. 689. This article was supplementary to his article on the same subject in the *Engineering Record*, Nov. 28, 1914, p. 585.

What follows is abstracted from Mr. Nagler's paper:

The success of the Nagler runner is due to its extraordinarily high speed under low-head conditions, or rather its surpassing characteristic speed, implying stipulated unit conditions. This speed is the result of two fundamental advantages afforded by the axial-flow principle: A minimum of wetted surface and a maximum of mechanical strength.

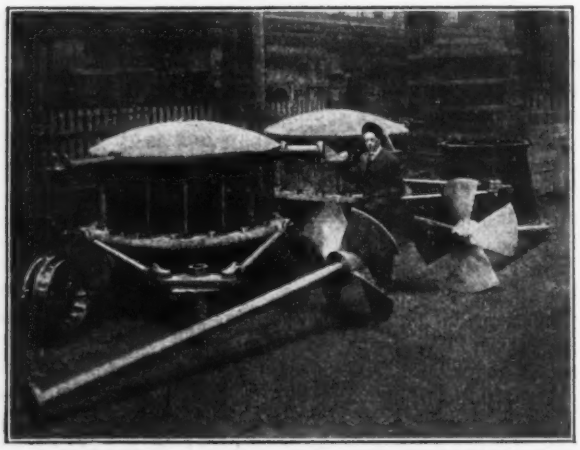
The entire design is based on the use of straight radial blades which offer little wetted surface for water friction, simple water passage, a minimum of centrifugal force, and a minimum of bending moment. Moreover, the high speed of water passage exerts an accelerating suction force on the back surface of the blades. This fact was demonstrated by an investigation of thrust and power which showed that the force

Variable Designs for County Highway Systems

THROUGH error the name of the author of the above-titled article, appearing in *Engineering News-Record*, Jan. 29, 1920, was omitted. The article was written by J. Y. McClintock, Superintendent of Highways, Monroe County, New York.

on each blade exceeds the product of blade area and total apparent head, which can only mean that there is less atmospheric pressure on the back side of the blade, aside from that due to the draft head.

It is difficult in practice to secure such high characteristic speed without correspondingly high velocities of water at the runner discharge. Such high exit velocities would incur tremendous efficiency losses were no draft tube or diffuser used. On low heads and large capacities a long, straight tube is usually uncommercial on account of the excessive excavation involved and some form of a radial-outward-flow type is practically necessary. White's "Hydraucone Regainer" has been adopted as the most perfect commercial solution of the Nagler runner's diffuser problem yet found



ONE OF THE FIRST COMMERCIAL APPLICATIONS OF THE NAGLER TYPE OF RUNNER

for general conditions, and practically all Nagler installations to date have been furnished with this hydraucone built either of steel or concrete.

Referring to the curves in the accompanying cut, the highest speed ordinarily offered in commercial work is typified by curve No. 4 Contrasted to this are shown curves Nos. 1, 2 and 3, the second of which is deduced directly from Holyoke test data. The most definite indication of the field of application of the new form of runner is obtained from the curves on the following basis: Under any given conditions of head and with such minimum limit of speed as might be imposed by consideration of cost, efficiency and floor space, runner No. 1 will give 140 per cent and runner No. 2 will give 65 per cent more power than runner types previously available as typified by No. 4. Comparison on a speed basis using equal power would illustrate the application of the new type as follows: Under any given conditions of head and power, runner No. 1 will give over 50 per cent and runner No. 2 will give over 30 per cent more speed than runner types previously available as typified by No. 4.

Railway Improvements Under Government Control Total $470,000,000

IMPROVEMENT work carried out by the United States Railroad Administration during the first 21 months of the period of its control of the railway system represented a total cost of over $470,000,000, but the work and cost were considerably less than the amount authorized, as war and other conditions prevented carrying out the program in its entirety. Including the plans initiated under the Railroad Administration and the improvements which it approved, but which had been undertaken previously by the railway companies, the estimated cost of works authorized on existing railways by the Division of Capital Expenditures from Jan. 1, 1918, to Sept. 30, 1919, aggregated $676,684,763. To this must be added $47,576,573 for the

TABLE OF AUTHORIZED AND ACTUAL EXPENDITURES UNDER UNITED STATES RAILROAD ADMINISTRATION FOR IMPROVEMENTS AND BETTERMENTS FROM JAN. 1, 1918 TO SEPT. 30, 1919

(Existing Lines)	Estimated Cost of Work Authorized	Expenditures on Work Authorized
Widening cuts and fills, filling trestles, etc.	$11,517,932	$7,842,780
Ballasting	14,507,142	8 453,089
Rails and other track material	58,003,071	35,092,758
Bridges, trestles and culverts	59,767,770	37,405,197
Tunnel and subway improvements	3,097,594	1,897,962
Track elevation or depression	18,291,659	5,076,323
Elimination of grade crossings	15,841,464	7,026,734
Grade crossings and crossing signals	2,478,006	1,680,190
Additional main tracks	70,823,713	45,792,210
Additional yard tracks, sidings and industry tracks	143,371,775	91,847,951
Changes of grade or alignment	9,419,410	5,934,899
Signals and interlocking plants	16,724,038	12,129,011
Telegraph and telephone lines	6,944,179	5,173,086
Roadway machinery and tools	2,715,119	2,309,365
Section houses and other roadway buildings	4,638,487	3,428,475
Fences and snowsheds; right-of-way, snow or sand fences	2,652,105	1,588,864
Freight and passenger stations, office buildings and other station facilities	42,597,676	27,762,436
Hotels and restaurants	1,287,688	995,927
Fuel stations and appurtenances	10,679,445	8,185,994
Water stations and appurtenances	16,305,180	11,427,297
Shop buildings, engine houses and appurtenances	79,027,908	71,060,353
Shop machinery and tools	28,239,075	18,262,783
Electric power plants, substations, transmission and distribution lines	22,771,064	14,919,592
Wharves and docks	7,184,238	3,705,132
Coal and ore wharves	6,724,902	5,339,656
Grain elevators and storage warehouses	4,640,599	3,310,998
Real estate	793,641	467,097
Assessments for public improvements	3,407,992	2,398,998
All other improvements	12,241,891	7,525,754
Total (excluding equipment)	$676,684,763	$448,040,911
Construction of extensions, branches and other new lines	$47,576,573	$25,928,064

construction of new lines, branches and extensions. Actual expenditures for such work during this period aggregated $448,040,911 for improvements and $25,928,064 for new lines, or 66 and 54 per cent respectively of the amounts authorized.

The classification of the work is shown in the accompanying table. The only large item in which performance approached the original program was that of "shop buildings, engine houses and appurtenances," the estimates and expenditures for which were $79,000,000 and $71,000,000 respectively.

Additional Water Supply for Manchester, England

A dam 100 ft. high, at the eastern end of a lake known as Hawes Water, together with minor storage and diversion works and an aqueduct about 54 mi. long, were authorized by the British Parliament in 1919 to provide an additional water supply for Manchester, England. The completed scheme would supply about 1,000,000 U. S. gal. per day, would cost about £10,000,000 (at normal exchange about $48,650,000), and would be carried on through a long period of years.

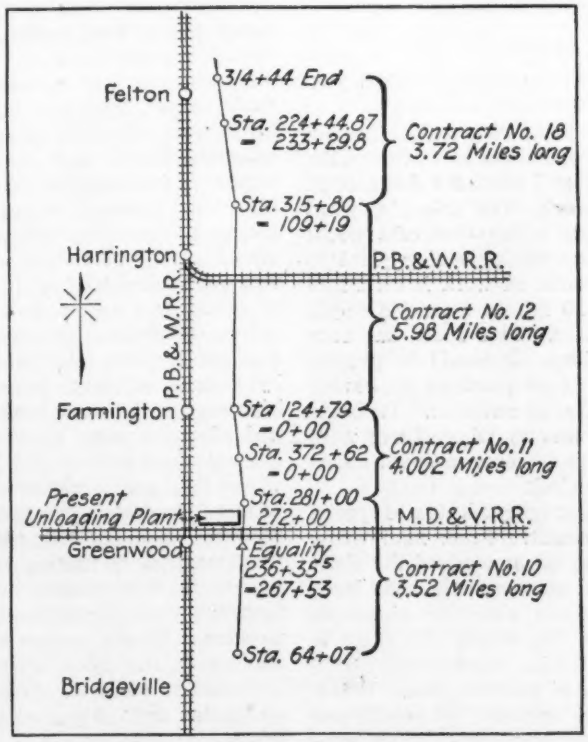
Continuity of Operation Essential to Success In the Use of Industrial Railway

Factors Making for Success Are Ample Provision for Materials Delivery, Correct Routing, Uninterrupted Transit, Co-ordination of Plant Units, Upkeep of Machinery

By H. Eltinge Breed
Consulting Engineer, New York City

WE ARE close to the second season of the new era in highway building. We approach it with high hopes, though also with uneasiness. Will this year bring better results and greater rewards for highway work, or will it be, especially for the contractor, another period of dusky doubt and dissatisfaction? The temptation is strong to offer patent pills of advice: "Do this or that—use this or that machinery; follow this method or the other, and all will be well." Unfortunately it won't. Success is not so cheaply had. We can't coast to quick conclusions on the basis of what happened last year. Rather, we must try to make our plans now through careful consideration of specific jobs undertaken—why they succeeded; why they failed; how they could have been better.

The McNichol job in Delaware is significant because it contains three important factors in this new phase of highway work. They are the long contract, the large scale contractor coming into highway work from other fields of construction, and the extensive use of machinery. It is significant also because it illustrates two principles which I believe will largely determine the success of this year's work — continuity of operation, and executive ability. It suggests a number of ways in which both of these principles may be attained.



POSITION OF THE FOUR McNICHOL CONTRACTS

The road runs from Bridgeville to Felton, Del. It was let in three contracts so as to interest contractors who wanted small jobs as well as those who wanted big ones. The McNichol Paving & Construction Co., of Philadelphia, got all three and later an adjacent fourth. So they are building a road 17.22 mi. long, 16 ft. wide, of concrete pavement 1:2:4 mix, 8 in. thick at center, 6 in. at the side, with a circular crown. All the materials are imported. The accompanying sketch shows the layout of the four contracts, and the railroad facilities for getting in materials. The railroad intersects the highway at Sta. 272, where an unloading plant is located. There is a twenty-car siding, nine cars east, and eleven west, of the highway.

The unloading plant proper is on the west side of the highway. It contains a traveling derrick with a three-drum hoist, having an independent swing, of a 180-deg. radius, and carrying a ¾-yd. clamshell bucket which runs on a track of 13½-ft. gage, parallel to the railroad siding on the left. On the right of the crane is a tunnel 200 ft. in length, with traps spaced so that material can be poured precisely through into the batch boxes on industrial railway cars as they are run into the tunnel and spotted. The clamshell bucket sticks its open mouth into one of the freight cars of the siding, closes up on a load, swings around its boom and bucket, depositing the load on top of the tunnel. Thence the material drops through the traps into the industrial railway cars.

The capacity of the storage area around and over the tunnel is about 90 cars of material—30 of sand and 60 of stone. This area could easily be increased. It offers the tremendous advantage in these days of oversold material markets of having an ample reserve supply on hand. It also saves demurrage. The additional cost of rehandling involved is slight.

The tunnel is built with track at the ground level, on such a grade that trains twenty cars long can be snubbed through the tunnel over a niggerhead at the entrance. A depressed tunnel would have required less rehandling of materials. The cost of the tunnel approximated $10 per linear foot, in place complete.

Beyond, to the west, as shown in the sketch, is a cement house 20 x 120 ft. of 3,000 bbl. capacity. Industrial track to and through the tunnel is laid from the highway on to the cement shed. Another track from the cement shed is run north of the tunnel back to the main highway where it joins the main line of the industrial railroad. The track used is a 25-lb. rail riveted onto pressed steel ties, each section being 15 ft. long. It was laid with unusual care, and consequently there have been fewer derailments and less trouble than on any other piece of work of this kind that the writer has seen. The maximum grade on the line is 2½ per cent.

The rolling stock equipment consists of three 6-ton

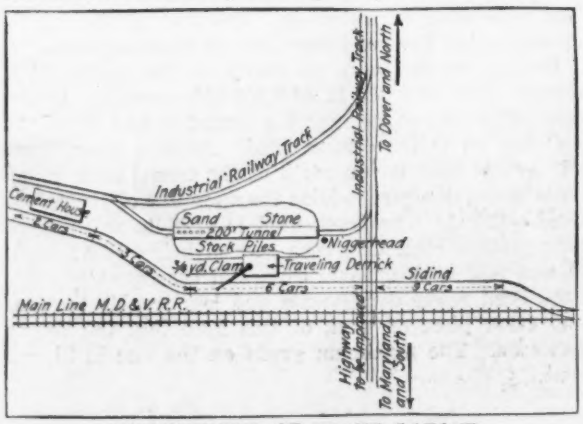
gasoline locomotives, each of which uses 16 gal. of gasoline and 1 qt. of oil in a 10-hr. day. Each of the three trains has 20 cars, and each car frame and running gear weighs 400 lb., on top of which sits a wooden batch box weighing about 700 lb. These batch boxes, which were made on the job by the contractor, are so partitioned that each one may carry cement. sand and stone up to a load of 2,800 lb. The boxes cost approximately $16 apiece to build.

They are shifted from the train to the concrete mixer by a small derrick attached to the mixer, which swings them around over the skip, where they are dumped by the batch transfer men. The mixers are of four-bag capacity with caterpillar traction. To surface the concrete a 10-in. channel iron templet weighing about 400 lb. is used. It has a narrow angle iron bolted along the inside center of the channel as a stiffener. Water for the work is furnished by pipe line and pump supplied from driven wells which cost approximately $50 each. Two miles of pipe were used on this work.

Average Output

With this equipment the average output, when running full, has been 430 ft. The best run as yet for a single hour is 25 batches. More men and equipment would have kept them both operating to full capacity, with a much greater output and resultant decrease in cost per unit for doing the work. The unloading plant has emptied nine freight cars a day—ten cars would be its utmost capacity. From the unloading plant to the day's final output the amount of work is estimated on the basis of a speed of 10 mi. an hour for empty cars and 8 mi. for loaded cars. This speed has been exceeded under good conditions. It would be greater on a job that provided for train passings by having through switches instead of stub switches. It would be decreased, however, in a country where there were grades. It is axiomatic that a decrease in speed necessitates an increase in rolling stock.

The Felton-Bridgeville section aptly illustrates special need for this kind of equipment. Team haul would have been out of the question on account of the character of the soil. It is a sand allowing only small loads of one ton or less to be drawn over the highways. Horses could ill have endured the strain. To make it sustain the weight of motor trucks, considerable planking would have had to be done at great expense. Industrial railway was the obvious solution. It would also be a feasible solution on any large jobs where considerable cross-country hauling away from highways is



ARRANGEMENT OF PLANT LAYOUT

STOCKPILES, STONE BEING UNLOADED BY CLAMSHELL

involved. It is advantageous in that it insures clean aggregates, prevents wastage of materials, and preserves the finished subgrade from the damage caused by hauling over it.

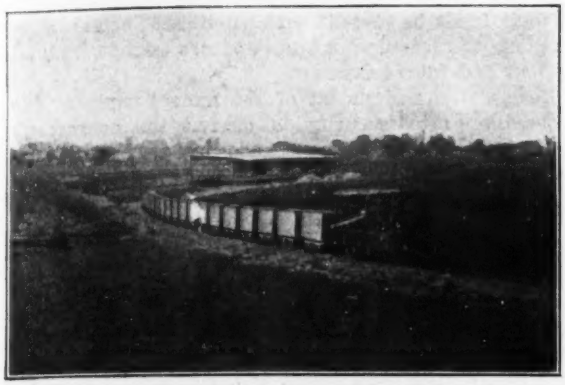
To operate this equipment and secure the average day's output, men are needed with decidedly greater intelligence than that of the ordinary day laborer. The extensive use of machinery has at least three advantages: It is giving us better, more dependable results than hand labor; it is enabling us to carry through a program impossible without it, because the present supply of labor is entirely inadequate for its performance; and, most valuable of all, it is raising the whole standard of intelligence required in highway work. The faster we can eliminate the untrained, ignorant uninterested day laborers, and substitute for them machines operated by trained, efficient, interested men, the sooner will highway construction work win due social recognition and adequate pay. Furthermore, we shall be freeing the untrained laborers for less developed fields by work where they are sorely needed. And, beyond the scope of our immediate work and interests, we may have the satisfaction of knowing that we are in step with that progress that is raising the whole standard of intelligence in this country by lessening the demand for ignorant workers and increasing the demand for skilled workers. Human nature responds quickly to demands made upon it. All of us are influenced to advance or backslide by what our social group requires of us. The contractor is a big factor in the highway workers' group.

Character of Labor

What happens when the contractor substitutes machinery and skilled labor for the old unskilled labor was clearly indicated on this job. The men were the most alert, eager, interested lot that the writer has ever met on a highway job. They were not mere cogs in a machine, but they were the directing force behind machinery whose successful operation depended upon the skill and effort of each one of them.

To begin with, on this job, it took one foreman and eight men one day to lay ½ mi. of track; the same gang, in the same time, can rip up ¾ mi. Given mileage and wage scale, to estimate that cost is merely a matter of multiplication.

Five men are required in the cement house, two to clean up around cars, etc., and three at the tunnel with the engineer, the fireman and the foreman of the gang. A blacksmith and his helper are required to do the



A STRING OF "EMPTIES" BOUND FOR CEMENT HOUSE

necessary repairing of equipment. Each train has an engineer and a train man to run it. Six men have been steadily busy keeping up the track. Around the mixer there is one foreman, four batch transfer men, three spreading concrete, two at the templet, one at the chute, one at the charging skip, two curing, two on the belt, one engineer, one fireman.

It is obvious that every one of these men must bring a certain amount of skill and of personal enthusiasm to his work. The natural corollary to this is that the men in charge possess executive ability.

Before a contractor goes in for the extensive use of machinery he wants to have one of those searching interviews with himself that is so likely to be unpleasant. What are his financial resources? What is his mental capacity? How great his executive ability? How strong his power to pick and to lead men? If he can answer these questions satisfactorily he is fairly safe in going ahead. Even then, however, he may meet reverses through too bad weather conditions, through inadequacy in the machinery, or some error in planting the job.

In the McNichol job, part of the machinery was too light. That there should have been heavier running equipment is proved by the number of broken trucks that piled up in the yard. Of their own volition, the machinery manufacturers are replacing the breakage with heavier gear. And the weather was as bad as any contractor might hope to be spared—only 26 fair days fom early June to late September. These two factors have so far kept the work on this job away below expectations; there is still time, however, if all goes well, for it to terminate successfully. Under satisfactory conditions of management and plant, the industrial railway of course gives low ton-mile cost in hauling large quantities long distances.

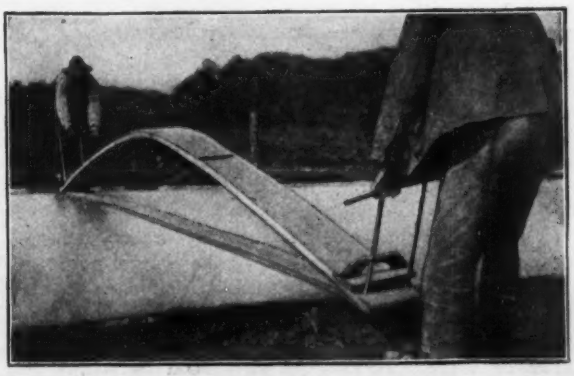
Success, in this job and in every other considerable highway job, depends upon one factor which includes every other factor that has been mentioned. Ample provision for delivery of materials, correct routing between unloading and destination, uninterrupted transit, co-ordination of plant units so that each one is working to capacity all the time, foresight in the management, skill in the workers, upkeep of the machinery, all these are directed to one end—continuity of operation. The structure of the concrete road requires it, the extensive use of machinery compels it.

The reason is apparent as soon as we realize what happens when continuity of operation fails. Let us assume that on the McNichol job there is $80,000 worth of plant. On this capital investment, interest, repairs and depreciation, by close estimate, amount to $162 a day, if we reckon 150 days for the working season; or $24,420 a year. Wages run to $240 a day. Estimating overhead expenses at $40 a day brings the total of fixed charges to $442 a day or $44.20 an hour.

So, on a job like the McNichol planted at $80,000, for every hour lost on work there is an approximate sum of $44 to be made up. Where there are defects in organization or equipment, lost hours here and there multiply rapidly. Soon the amount in arrears exceeds possible profits, and the job financially has failed. It has lacked continuity of operation. With it, it would have succeeded.

How is continuity of operation to be attained? Let us look again at the McNichol job as it will be run under favorable conditions during the coming season. The cement, sand and stone come in standard cars and are switched onto the railroad siding shown in the sketch. The bagged cement is unloaded by hand labor into the cement house. The sand and stone are unloaded, one car at a time, over the tunnel. The stone is unloaded over ⅔ of its length and the sand over the other ⅓. As each car is emptied the crane moves along to position for the next car, and when all those within reach are unloaded others are drawn into position. This part of the plant can work as long as there are cars to unload and a place to pile up the material.

The empty train of twenty cars is pushed into the tunnel and snubbed through by a rope over a niggerhead so that the cars are spotted with the stone compartments under the stone chutes. After these compartments have been filled with stone the train is moved along to position under the sand chutes and the sand compartments are filled. The tunnel is on a grade. As the train comes out from the lower end the locomotive couples on and pulls it on to the cement shed where it is loaded with the cement. When the journey to the mixer is started other trains along the line are passed on stub switches. Finally the mixer is reached. The bail at the end of the derrick cable is attached to the bucket, which is raised from its truck and swung over the charging skip into which the material is dumped. While the skip is being raised to charge the mixer drum, the empty box is returned to the truck and a loaded car moved into place. The materials after being mixed in the mixer drum 90 sec. with the addition of the proper amount of water are discharged as concrete onto the chute and thence onto the subgrade. There the concrete is spread and spaded between steel forms on which rides the channel templet operated



FINISHING WITH BOW BELT

by two men. Spading of the concrete is done in such a manner as to keep a uniform surplus amount ahead of the templet, which levels and strikes the concrete off to a uniform surface by moving it back and forth over the forms, advancing a little with each forward and backward motion. As soon as desirable a roller of 100-lb. weight is put on the green concrete. This rolls the water out. Soon a belt 8 in. or 10 in. wide is drawn back and forth over the concrete, advancing a little with each stroke. A second belting often adds to the smoothness. As soon as the belting is finished the curing commences, for which the concrete is covered with canvas tarpaulins on raised frames. When the concrete has hardened sufficiently an earth cover is put on to a depth of 2 in. The concrete is then sprinkled often enough each day to keep it continuously moist for a period of 10 days. After four days more the earth cover is removed and the completed section thrown open to traffic.

There are two other unique features on this work besides the steel channel templet described. One is the bow belt described in the *Engineering News-Record*, issue of July 3, 1919, p. 40. The other is the locking of the slabs together at the joint by the use of five ¾-in. steel bars 2 ft. long. One foot is encased in the last slab laid at night; the other foot projects toward tomorrow's work. Next day over these projecting rods cardboard tubes are snugly slipped, and they are encased in the new concrete. The advantage of this method is that the slabs can never rise above one another and the paper tube on the one end of the rod allows for contraction without breaking the slab.

This brief description makes obvious the interdependence of all the steps, from the arrival of the first supplies to the laying of the last square yard. When the chief is big-minded enough to direct all the essentials, when his subordinates capably execute all the details, when deliveries are prompt, and each plant unit plays its part, then you get continuity of operation and orderly, satisfactory progress.

Italy Authorizes Credit Corporation to Finance Public Works

AN Italian royal decree has recently established a credit corporation through which funds are immediately available for carrying on public works, thereby providing employment for a large number of workers and discharged soldiers who are unemployed. This corporation, or "consortium," is composed of the Office of Deposits and Loans, the National Insurance Institute, the National Office of Social Insurance and the saving banks which make application for membership. It is an autonomous body, but is subject to the supervision of the Ministry of the Treasury. The initial capital of the consortium is 100,000,000 lire ($19,300,000, normal exchange), of which 60,000,000 lire will be subscribed by the Office of Deposits and Loans. As its membership increases, the capital may be increased to 150,000,000 lire.

In addition to lending its capital, bonds may be issued by the consortium, guaranteed by the annual payments due from State, which act as security for loans granted by the consortium. These bonds may be traded in by the stock exchanges, may be accepted as collateral by banks of issue, and may be purchased by banks and other institutions which are obliged to carry all or part of their funds in government securities. They are subject only to a small stamp tax and are exempt from all present and future taxation.

Besides the assignment of the annual payment due from the State, security is offered the consortium through the contributions made by provinces, com- from the State, security is offered the consortium makes funds immediately available without delaying progress of the work until further payments from the government become due.

If, says a recent issue of *Commerce Reports*, the commencement of public work was forced to await the ability of the Italian Government to provide necessary funds, much valuable time would be lost, for the financial condition of the government is such that its expenditures must be reduced to the lowest possible limit.

Just the Same in the Antipodes

IT WAS generally anticipated that costs of construction would rapidly drop after the signing of the armistice, and the majority of engineers anticipated that in about 12 months, with the release of labor and shipping and the return to normal conditions, prices and freights would drop to a reasonable percentage above pre-war costs. It was hoped that, with the labor-saving appliances and new machinery established in Great Britain during the war, the cost of a large number of items of machinery would have been even below pre-war rates.

In no respect have any of these anticipations been realized, as the following instances will indicate:

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In addition to our increased cost we have, perforce, to pay customs duty on the increase; and should, as has often happened, the selling price of machinery increase between the date of ordering and the date of supply, we have also to pay duty on the difference.

Unskilled labor is now receiving a wage 20 per cent higher than a few years ago, but one would not particularly emphasize this point if pre-war efficiency was being maintained. The fact remains, unfortunately, that the average efficiency of unskilled labor today is much below what it was when the first stage of our scheme was being constructed; in other words, the unit costs at present greatly exceed the unit costs in the old days. Tenders which have been received from time to time from contractors confirm that they anticipate the same results as we have secured, and unless some means can be devised to rectify this state of affairs, not only in connection with our departmental work, but generally, a very serious position will undoubtedly arise.—From the Annual Report, 1918-19, of J. H. Butters, chief engineer and general manager, Hydro-electric Department, Tasmania.

Asphaltic Concrete Laid on Gravel Base

Care in Laying Foundation and in Compacting Base Underlie Efficient Service — Type Recommended When Resources Preclude Use of Concrete Bases

By E. F. Petersen
Consulting Municipal and Highway Engineer, Texarkana, Ark.

PAVING Improvement District No. 20, of the City of Texarkana, Ark., was organized under the general laws of the state relating to improvement districts in cities and towns. As considerable objection existed at the time on the part of certain citizens to the formation of the district, its validity was contested by those opposed to it. The legal fight that followed resulted, however, in the validity of the district being sustained by the supreme court of the state, in consequence of which decision the commissioners at once proceeded to get the actual work of paving under way. Bonds in the amount of $150,000 were sold in May, 1916, and the following month the writer was retained as engineer to prepare the plans and specifications and supervise the construction of the improvements.

The street area in the district between curbs before the improvements were commenced was approximately 205,000 sq.yd. About 95 per cent of this area consisted of gravel streets, blue stone curbing and stone and brick guttering. The remaining streets within the boundaries of the district were practically unimproved except for occasional curb and gutter built by abutting property owners.

Of the 205,000 sq.yd. above referred to about 89 per cent consisted of streets averaging 52 ft. in width between curbs. The gravel upon these streets was all pit run and had been down for some time, during which period its maintenance had been very poor. These streets were therefore badly worn and tests made by the writer showed the thickness of the gravel varied from practically nothing in places to 6 in. and 7 in. near the gutters where the traffic had been light.

Previous to the writer's connection with the work the Board of Commissioners had an engineer investigate and report upon the question of improving the streets in the district. As a result, it was recommended that they be surfaced with 2½ in. of asphaltic macadam (penetration method) between the existing curbs, using the existing gravel for a base, after there had been added to it further gravel in a sufficient amount to secure the proper crown. On the ungraveled streets the same type of surfacing on a gravel base newly built for this purpose was to be laid.

The procedure just outlined was to be followed on all streets in the district, with the exception of several in the business section, which, it was recommended, should be surfaced with creosoted wood blocks laid on the existing gravel base, being first renovated, as described above. It was estimated that this method of procedure would permit the streets to be improved in a satisfactory manner, including adequate storm sewers, for the $150,000 provided.

Asphaltic Concrete Recommended

A thorough investigation by the writer of existing conditions and his previous experience with, and observation upon, the types of surfacing recommended, resulted in the conclusion on his part that neither type of surfacing under the conditions imposed would prove satisfactory or be justified. He therefore recommended that the wood block surfacing be entirely abandoned and a 3-in. vertical fiber brick pavement with cement grout filler be used on the more heavily traveled portion of the business section. A 2-in. asphaltic concrete wearing surface laid on a 6-in. or 7-in. gravel base (choice depending on subgrade and other conditions), was suggested for

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The street area in the district between curbs before the improvements were commenced was approximately 205,000 sq.yd. About 95 per cent of this area consisted of gravel streets, blue stone curbing and stone and brick guttering. The remaining streets within the boundaries of the district were practically unimproved except for occasional curb and gutter built by abutting property owners.

Of the 205,000 sq.yd. above referred to about 89 per cent consisted of streets averaging 52 ft. in width between curbs. The gravel upon these streets was all pit run and had been down for some time, during which period its maintenance had been very poor. These streets were therefore badly worn and tests made by the writer showed the thickness of the gravel varied from practically nothing in places to 6 in. and 7 in. near the gutters where the traffic had been light.

Previous to the writer's connection with the work the Board of Commissioners had an engineer investigate and report upon the question of improving the streets in the district. As a result, it was recommended that they be surfaced with 2½ in. of asphaltic macadam (penetration method) between the existing curbs, using the existing gravel for a base, after there had been added to it further gravel in a sufficient amount to secure the proper crown. On the ungraveled streets the same type of surfacing on a gravel base newly built for this purpose was to be laid.

The procedure just outlined was to be followed on all streets in the district, with the exception of several in the business section, which, it was recommended, should be surfaced with creosoted wood blocks laid on the existing gravel base, being first renovated, as described above. It was estimated that this method of procedure would permit the streets to be improved in a satisfactory manner, including adequate storm sewers, for the $150,000 provided.

Asphaltic Concrete Recommended

A thorough investigation by the writer of existing conditions and his previous experience with, and observation upon, the types of surfacing recommended, resulted in the conclusion on his part that neither type of surfacing under the conditions imposed would prove satisfactory or be justified. He therefore recommended that the wood block surfacing be entirely abandoned and a 3-in. vertical fiber brick pavement with cement grout filler be used on the more heavily traveled portion of the business section. A 2-in. asphaltic concrete wearing surface laid on a 6-in. or 7-in. gravel base (choice depending on subgrade and other conditions), was suggested for

THOUGH SUBJECTED TO HEAVIEST TRAFFIC FOR TWO YEARS, ASPHALTIC CONCRETE ON GRAVEL BASE HAS NOT FAILED OR DETERIORATED

certain other portions of the district and a 2½-in. asphaltic macadam wearing surface laid on a 6-in. or 7-in. gravel base was proposed for certain of the less traveled residence streets. It was further recommended that a concrete base be used on a certain number of the downtown streets for some of the asphaltic concrete wearing surface. The widths of all streets, with a few exceptions, were to be reduced to a maximum of 30 ft. and a minimum of 20 ft. All gravel base was to be entirely new, and laid in accordance with the requirements of specifications especially prepared for this purpose by the writer.

Owing to the limited amount of money available, the above recommendations seemed to offer the best solution of the problem presented. In general these recommendations were adopted by the commissioners and bids opened accordingly on Oct. 30, 1916.

A number of bids were received and their tabulation showed a great variation in prices for doing the work, especially for the gravel base, which constituted a separate item among many others on which unit prices were received. However, the contract for the entire work was finally awarded to the Burke Construction Co., of Fort Smith, Ark., under date of Nov. 29, 1916. The work has been in process of construction ever since, conditions resulting from the war, among other untoward circumstances, having prevented the completion on the contract within the prescribed time limit.

In awarding the contract, however, all types of construction were eliminated except the asphaltic concrete wearing surface and 3-in. vertical fiber brick, both to be laid on gravel base, except that a 4-in. concrete base was to be used in certain places if the money available for the work permitted. These conditions and restrictions were imposed by the commissioners, owing to the limited funds available, and because it was felt every street should be paved in fulfillment of pledges to property owners who made possible the formation of the district.

As the use of the gravel base presented, when adopted on such a large scale, an entirely new departure from established and recognized practice, the writer felt that much interest would attach to the work and, in event of its successful accomplishment, much benefit to other communities desirous of making paving improvements, but with such limited funds at their disposal that concrete or crushed stone base would be impossible on account of their cost.

Character of Subgrade

The character of the underlying soil throughout the district is such, with a few exceptions, as to afford an excellent subgrade for any base laid upon it, and consists of a dense red and blue clay, containing in places a small amount of fine sand intermingled with it. The subgrade for the gravel base is prepared in the same manner as required by good practice for concrete base, except that the allowable variations from the theoretical finished cross section is not confined to such close limits as is usual with the former.

In view of the writer's experience with, and observation of, asphaltic concrete laid on a macadam or crushed stone base and the satisfactory results obtained by its use in writing the specifications for the gravel base to be used in this instance, it was endeavored to stimulate as much as possible that form of construction with the gravel available. It was therefore specified that the completed base would contain at least 70 per cent of coarse material or gravel particles, i.e. material retained on a ¼-in. screen, the grading of the coarse material ranging from the smallest to the largest particles, within reasonable limits, in such proportions that the minimum of voids would result. The base is laid in two courses, and the greatest diameter of the largest particles must not exceed 2½ in. The fine material or binder filling the voids in the coarse material must all pass a ¼-in. screen, and if ideal will consist of a uniformly graded sand containing a sufficient amount, evenly distributed, of clay to fill the voids in the sand. This sand and clay mixture or binder in the completed base should just a little more than fill the voids in the coarse material.

As is well known to those experienced in the use of gravel for road-making purposes, the material as taken from the pit varies in quality and proportion of fine and coarse material, in the same pit from place to pit, and in different pits, to such an extent that the mixture above described is very seldom found in nature. It therefore has to be artificially attained by the addition of the defaulting material, and by the proper manipulation of these ingredients in bringing them together. Material taken from inland gravel pits as distinguished from gravel secured from river beds, is usually deficient in the coarse material, and, where the binder as it occurs in the pit run material is satisfactory, therefore requires only the addition of screened gravel in the proper quantity to make up the deficiency.

Method of Laying Base

The screened gravel for each course of the base is first spread uniformly to the proper depth and the pit-run material then laid over the screened gravel. These two materials are then thoroughly mixed together by harrowing with an ordinary spike harrow properly weighted, after which the mixture is thoroughly rolled with a ten-ton, or heavier, road roller. The amount of screened gravel required is determined by the result of the quantitative analysis of the fine and coarse materials in the pit-run gravel. A little experience with the materials being used will soon enable the engineer or inspector to recognize approximately by visual examination the relative amounts of the two materials necessary to secure the desired results. The harrowing is very important, quite inexpensive, must cease at the right time, and is the only means of effecting the proper and uniform incorporation of the various sized particles making up the base. If, when the rolling of the base is completed, the surface of the latter appears to have too much gravel in places, so that it is loose and will not remain in place, a thin layer of fine material (or what for convenience we call a "squeegee" coat should be spread over the surface. The thickness of this squeegee coat need not exceed a quarter of an inch and the material of which is is composed will quickly, under traffic, fill in the spaces between the loose gravel. Any excess above what is required for this purpose will be blown away, or carried away by the traffic. These operations having been completed, the base should be thrown open to traffic for a period sufficient to effect a thorough and uniform consolidation. The length of this period depends on the cementing quality of the materials used, the weather and the amount of traffic. With the material available in Texarkana the writer has laid the topping upon the base within two weeks after the latter

was completed. In other instances the topping has not been laid until a year after the completion of the base, because of the shutting down of the asphalt plant and failure to start again before this period had elapsed. Observation of completed pavement laid under both circumstances has thus far shown no inferiority or superiority in either case.

The preparation of the base for the reception of the asphaltic concrete wearing surface just preceding the laying of the latter is an operation requiring extreme care and careful inspection. During the period the base has been open to traffic it will have become covered with dirt and extraneous matter of various kinds and amounts, and if laid on a grade, rains which have occurred in the interim will probably have caused washouts, particularly along the gutters. The latter are the source of considerable trouble, as the water has generally washed out the clay from the binder, leaving loose sand and gravel in deposits, which the contractor is generally anxious to cover up or use again in repairing the base. These washouts are first thoroughly cleaned out by removing all loose and foreign material and filling in to grade with suitable material of quality before described.

The whole top surface of the gravel base is now thoroughly swept with a horse-drawn rotary broom of the ordinary street-cleaning type. Matter adhering to the base which cannot thus be removed is then loosened with picks, after which the whole base is carefully swept by hand with ordinary stable brooms, with wire or stiff fiber bristles, the latter being preferred. If the base has been properly laid the whole surface, after being swept, will have a honeycombed appearance, the tops of the gravel particles being exposed to view, and thoroughly interlocked and held tightly in place.

Irregularities in Crown

Irregularities in the established crown cross-section not exceeding a half inch need not be corrected in the base, as an experienced raker will soon learn to do this by varying the thickness of the topping material accordingly, so that the surface of the finished pavement will present the same evenness and smoothness as if laid on a carefully prepared concrete base.

High spots are removed with picks after the base has been swept with the rotary broom. Depressions exceeding one-half inch in depth below the established crown cross-section, and not exceeding three inches, are readily brought to grade by the use of close binder thoroughly rolled or tamped in place. Where the base has been properly laid and not subjected to traffic for too long a time, or been washed by storm water, irregularities requiring correction in this manner, of course, will not occur.

It should also be stated in this connection that the filling up of depressions with asphaltic binder is an alternative allowed the contractor, instead of requiring him to repair the base with gravel. Except where the base is very badly damaged, its use is cheaper than would be the case were the base brought to the required crown by scarifying and adding the requisite amount of new gravel material and then compacting properly in place, as the asphalt plant, once started, interruptions to its continuous operation are expensive. The binder used is the same mix as specified for the wearing surface, except that no limestone dust or portland cement is required and the amount of asphalt cement used is about 1½ per cent less than for the surface mixture.

The gravel base having been prepared and swept thoroughly clean in the manner described, it is now ready for the reception of the asphaltic concrete topping or wearing surface. The wearing surface consists of a topeka mix, spread so as to have a thickness of 2 in. after compaction. It is prepared and hauled to the street in the usual manner, but instead of dumping the load directly onto the base it is loaded upon a sheet-iron dumping board about 14 ft. by 10 ft. laid upon the base. This board, from which the mixture is shoveled into place for the rakers, is pulled ahead of the spread material as fast as the progress of this branch of the work requires. As soon as the board is moved ahead, the surface of the base, just ahead of the material laid last, is swept again so that droppings from the shovels and any other loose or foreign matter due to the operations of unloading and spreading the mixture will be entirely removed. In all other respects the gravel base is similar to the practice employed when a concrete base is used. Extreme care must be used that the gravel base is thoroughly dry before the topping is laid upon it.

No Failure or Deterioration

To date about 55,000 sq.yd. of the pavement described have been laid in this paving district. Of this amount 26,000 sq.yd. have been down for a little over two years, the balance having been completed and opened to traffic for about fifteen months. During this time these streets have been subjected to more than the customary traffic in view of the fact that they are practically the only paved streets in the city. In spite of this, however, no failure or deterioration of any character has developed in the pavement due to any cause arising from the nature of its construction. Not one crack or roll in the wearing surface—so common in asphaltic pavements laid on concrete base—is to be found over this entire yardage. Construction joints, made as butt joints, and where last year's work joins that of the previous year, have in no instance pulled apart.

In several instances water and gas mains have sprung leaks, resulting in the destruction of the asphalt surface where the water or gas came in contact with same. This occurred quite shortly after the pavement was laid. These leaks were stopped promptly by digging up the street and repairing the defective joints. After they were repaired and the back filling had settled sufficiently, the pavement itself was patched in the following manner: The gravel base was cut through for its full depth over a sufficient area so that the sides of the hole thus made were as nearly vertical as the nature of the material permits. This hole was then filled with concrete to the level of the top of the gravel base. When the concrete had set properly the asphalt wearing surface of the street was cut back about eight inches entirely around the joint between the concrete and gravel base. The edges of the asphalt, where thus cut, were then painted with hot asphaltic cement, and the patch made in the usual manner. About fourteen of these patches have been made to date, all of them being at least a year old now, and necessitated by leaks in water or gas mains.

These patches are in perfect condition and to all practical purposes are an integral part of and cannot be detected from the rest of the surfacing. The writer has enforced a large number of maintenance contract bonds where the customary concrete base was the supporting agent for the asphalt surfacing, but has never in any

instance succeeded in securing such satisfactory results on the concrete base as those just described in connection with the gravel base.

Conclusion

The writer has gone into the details given in this article because, as far as he is advised, the work described is the first piece of extensive asphaltic concrete paving construction laid on a new or specially prepared gravel base. As stated at the beginning of this article, owing to the limited funds available for paying for the work to be done, it was impossible to adhere to the standard practice by using a concrete or crushed-stone base.

The view accompanying this article is typical of the completed pavements and shows portions thereof laid in October, 1917. The view shown was taken October, 1919, and is of a street over which heavily loaded log wagons and trucks have been constantly passing for the past two years. This pavement, however, is in perfect condition.

Plans and specifications for the entire work were prepared under the direction of the writer and the work is being done under his supervision. About 65,000 sq.yd. still remain to be laid before the work contemplated is entirely completed.

Inspection and tests at the ashpalt plant have been in charge of the Pittsburgh Testing Laboratory, and all asphalt used is Texaco No. 54. Special credit is due the chairman of the Board of Commissioners, John P. Kline, former mayor of the city, as it was through his efforts, against a very bitter opposition, that the improvement was made possible. He was ably assisted in this connection by the two other members of the board, Paul Huckins and Milton Winham, and the attorney for the board, Frank Quinn.

Fast Roadbuilding With Concrete Hauled Four Miles

Six-Mile Road Concreted From Central Mixing Plant—Frequent Records of 500 Feet Daily With Two-Mile Haul

WET concrete has been successfully hauled two miles, and will be hauled a maximum distance of four miles, in building a six-mile section of the Dixie Highway extending north and south from Grant Park, Ill. A speed of construction is being obtained, with this long-distance wet haulage, which compares well with the average shown by more common methods of placing concrete directly from the mixer, and the concrete is passing, with no difficulty, the most rigid inspection of the Illnois Division of Highways. The plant investment is comparatively moderate and the equipment is nearly all of a character suitable to construction operations other than roadbuilding.

The alignment of the main operation is approximately as indicated by the sketch Fig. 1. Grant Park, situated about two miles from the south end and served by the Chicago & Eastern Illinois R.R., is the main town on the route, and in the plan of construction was made headquarters of the operation. This plan was to place a permanent mixing plant at Grant Park and haul the mixed concrete to the road. First, the two-mile section from A to B was completed; then construction was begun at C and advanced toward B. Finally, with the two miles of concrete road from B to A ready for

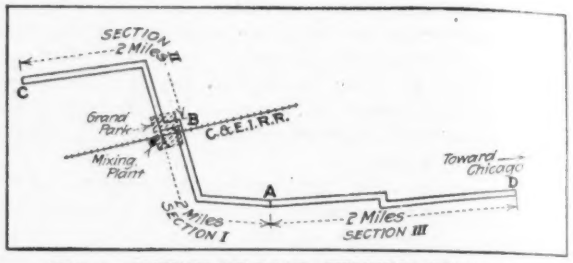


FIG. 1. SKETCH OF ROAD, SHOWING SEQUENCE OF OPERATIONS

traffic, construction will start at D and proceed toward A. By this procedure the old macadam provided a hard road for hauling concrete the full length of each section, except the few hundred feet just ahead of the tamper where the subgrade was in preparation, and when the final two miles calling for maximum haul is placed under construction two miles of this haul will be over finished pavement, permitting fast travel of motor trucks.

At Grant Park the contractor found a fortunate condition in respect to railway accommodations. The switch and yard tracks of an old brick plant abandoned because of fire were in place in good condition and so located that little improvement could have been made had they been laid down new. On this existing track system the central concrete plant was laid down as indicated by the sketch Fig. 2.

Besides having at his hand a track system providing unusual car storage space, the contractor was fortunate in his location in respect to materials train service. The C. & E. I. R.R., being a coal road, with a preponderating tonnage of coal trains north to Chicago, and the crushed-stone supply being from the north, the railway was alert to the opportunity of obtaining loads for the cars normally running south empty to be loaded with

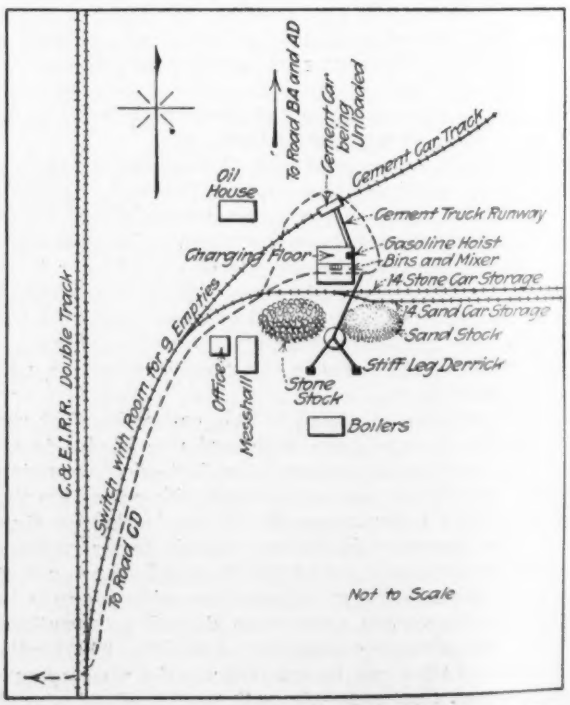


FIG. 2. SKETCH PLAN OF CENTRAL MIXING PLANT AND TRUCK SYSTEM

coal, and the contractor at no time lacked for materials Ample provisions, however, were made for storage, and stock piles for five days' operations were maintained.

The hub of the concrete plant is the bins and mixer house. A 50-cu.yd. stone bin and a 30-cu.yd. sand bin are elevated on a timber structure above a 1-cu.yd. mixer which is itself set high enough to discharge directly into the truck bodies. To the rear of the bins and just above the mixer is a charging platform housed in and connected with the cement-car track by an inclined runway on a trestle. The arrangement of the charging floor is indicated by the sketches Fig. 3. Stone- and sand-measuring boxes on cars, charged from any of the bin gates, are run to the hopper and emptied, and the cement bags are untied and emptied directly from the truck car on which they are hauled from the cement car up the runway by a gasoline hoist. A stiff-leg derrick, Fig. 2, with a 1-cu.yd. bucket, keeps the bins filled from cars or stock piles.

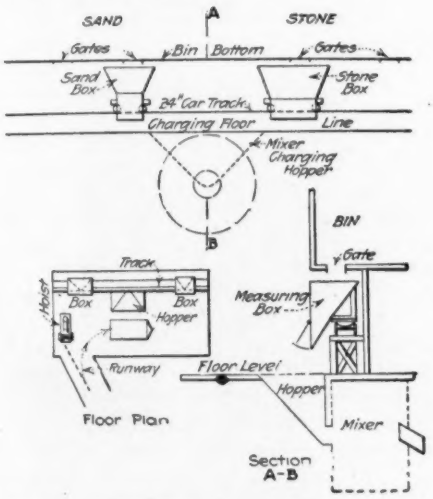


FIG. 3. SKETCHES OF CHARGING-FLOOR ARRANGEMENT AT MIXING PLANT

On the road the grading is kept about 1000 ft. ahead of the concreting. The old macadam is routed up by a heavy combination grader and scarifier hauled by a caterpillar tractor, Fig. 4, and is handled by wheeled scrapers, eight in number. A blade grader finishes the subgrade and a 10-ton roller compacts it. Hand work is reduced to a minimum. Hauling on the finished subgrade causes some rutting, and this makes repairing and rerolling necessary. A five-ton roller operated just ahead of the concreting performs this rerolling.

An 18-ft. concrete slab is being built according to the specifications of the Division of Highways of Illinois. The trucks back up to this slab and rear-dump as shown by Fig. 5. Men pull down the pile and rough-spread the concrete, which is then finished by a tamping machine. Truck haulage is the only unusual operation.

Wet-batch haulage on this job has demonstrated the practicability of making a round trip of four miles (two miles from mixer to road and return) in 30 min., and the practicability of constructing 532 ft. of 18-ft. road in nine hours, with eight trucks, each with a 2-cu.yd. batch, in operation. While hauling causes no segregation of the ingredients in concrete of the stiff consistency specified this year by the Illinois Highway Department, a tendency of the coarse aggregate to

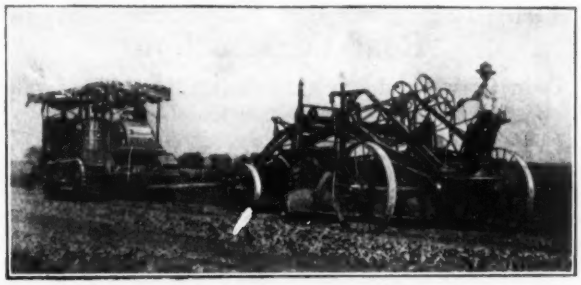


FIG. 4. TEARING UP OLD MACADAM ROAD

settle is noticeable in any batch that chances to be too wet. A thorough remixing is effected, however, by the process of dumping, spreading and tamping. The sticking of the concrete to the bottom of the dump body causes some delay, in picking and hoeing loose the clinging material. A remedy is being sought on this work by using a false bottom which will swing free and shake loose the bottom concrete when the body is tilted.

Accurate routing of the trucks is essential to steady and rapid construction. Eight trucks have been operated on the sections requiring a maximum haul of two miles, and this number has been barely sufficient to keep uniform and continuous the pace of the mixing plant and the paving gang. For the four-mile haul on the final section to be constructed, it is estimated that five additional trucks, or a total of 13 trucks, will keep the operation moving steadily. With the two-mile section of completed pavement over which to make speed, it is estimated that one round trip of four miles can be made in 45 minutes.

To maintain the rates of progress which have been mentioned, an operating force of 76 men, exclusive of superintendence and office help, has been required. This force is employed about as follows: Six men handling and unloading cars and filling bins; 5 men unloading and handling cement to mixer floor; 7 men, including foreman, charging and operating mixer; 2 men shaking and baling cement sacks; 10 men with eight trucks hauling concrete to road; 21 men, including foreman, grading and maintaining subgrade; 6 men setting and moving forms; 10 men, including foreman, spreading and finishing concrete; 9 men covering and watering slab.

The Embankment Co. of Joliet, Ill., has the contract for this road and all operations are in direct charge of James L. Bannon, president, and Robert J. Bannon, secretary of the company. Mr. R. B. Airey is superintendent for the contractor.

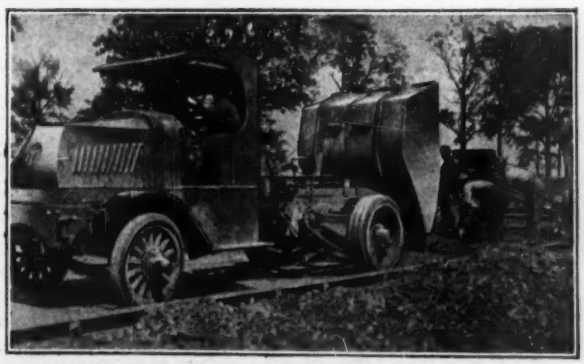


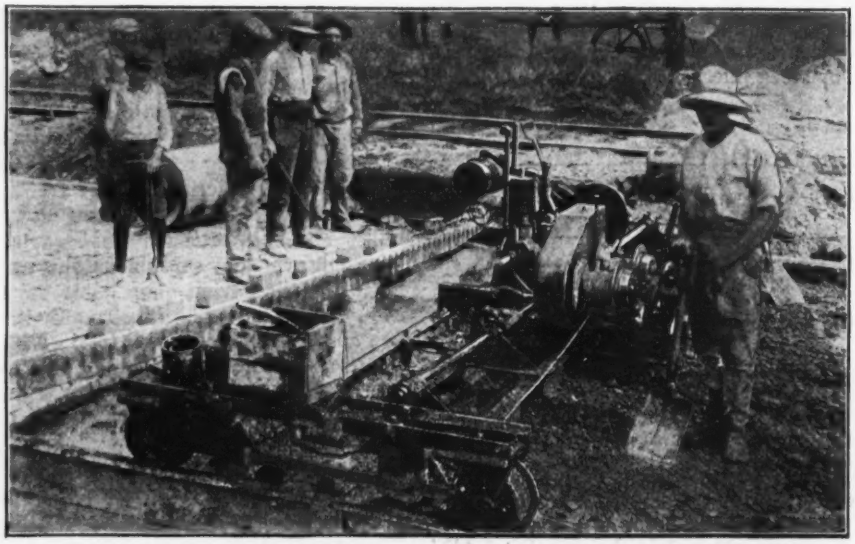
FIG. 5. TRUCK DUMPING CONCRETE ONTO SUBGRADE

Tamping Templet Expedites Brick-Road Construction

Twin Crews and Mechanical Outfits Build Twelve Miles in Three Months—Cost of Slab Analyzed

By F. A. Churchill
Dunn Wire-Cut-Lug Brick Co., Conneaut, Ohio

TWELVE miles of monolithic brick road from Ashtabula to Conneaut, Ohio, were completed this season in 92 elapsed working days. Two outfits and two crews were employed. Mechanical operations were substituted for hand methods wherever practicable, and, with a full supply of brick hauled in and stacked during the winter and the prompt delivery of concrete materials by a parallel interurban railway, they were largely to be credited for the excellent progress. In particular, automatic tamping templets expedited the base construction. They reduced its cost, the contractor estimated, about 15c. per square yard.



AUTOMATIC TAMPING TEMPLET AND GANG FOR LAYING MONOLITHIC BRICK

The improvement is 11.92 miles on the main traffic route between Cleveland, Ohio, and Buffalo, N. Y., where the old highway was especially bad. A heavy automobile and motor-truck traffic demanded substantial design, and monolithic brick construction was decided upon.

A 16-ft. slab of 4-in. wire-cut-lug brick, with 1:1½ cement grout joints on a 6-in. base of 1:3:6 concrete, was the design adopted. This slab slopes uniformly to a shallow concrete gutter 2 ft. wide on the side adjacent to the parallel electric railway. Catch-basins at intervals receive the water from the gutter, and tile drains run directly under or near the gutter, with lateral drains to carry the water away from the slab. Being very shallow, the concrete gutter is virtually a 2-ft. addition to the width of the brick road slab.

Construction preliminary to putting in the concrete base required no processes out of the ordinary. As soon in the autumn of 1918 as the contract was awarded, the contractor began the delivery and storage along the work of his full supply of about 4,500,000 brick. Motor trucks of all sizes, from one ton to five tons, were employed, and as many as could be operated continuously during the winter. The average haul was about two miles, and the cost of hauling, from siding to stock piles, averaged $4.20 per thousand, or 11c. per square yard of pavement. The average cost of brick piled on the job was $10.70 per thousand. Materials for concrete were hauled by the electric railway which paralleled the improvement. They were brought onto the work as needed after the subgrade preparations, and were dumped directly onto the subgrade.

To hasten construction, two outfits and two complete construction crews were planned. These crews began work at the center of the improvement and worked away from each other toward the ends. Each plant comprised a concrete mixer, a tamping templet, a roller conveyor for delivering bricks to the layers, two small mixers for building concrete gutter, and the necessary hand tools for concreting and grouting. Subgrade preparation followed the usual practice. As soon as it was completed, the steel side forms were set exactly to grade and width. While the templet has wide wheels to allow for inequalities in setting the forms, precision was considered essential to prevent the consumption of excess materials. The sequence of construction operations were then (1) mixing and depositing the concrete roughly to thickness; (2) tamping and finishing by the power templet; (3) brick-laying, rolling and grouting; (4) gutter construction.

Tamping, shaping and finishing the base slab with a templet of the Parrish type were the distinctive operations. This templet differs from others by its ability to tamp between the side forms and below their tops as well as flush with their tops. It operates and advances by its own power, always in a forward direction, just behind the concrete mixer, but in no way connected with the latter. The motor power is a gasoline engine, placed in the center of the framework and geared to the shaft, as shown in the accompanying illustration. Clutches and levers regulate the speed, and stop and start the machine. Small steel cables, winding around drums on the templet and carried ahead and anchored to steel stakes driven in the ground, draw it forward evenly and steadily, as the surface is finished. The clutches on the drums operate independently, so the templet can be adjusted to work on curves.

The tamping face of the templet is shaped to the true crown of the pavement, and the mechanism is so adjusted that it delivers 65 successive taps on each section of the foundation covered. These blows are light, but they are delivered rapidly, and the result is not only a perfect contour for the uniform bedding of the brick but a thoroughly compacted foundation of uniform consistency throughout. The tamping also brings to the

surface, if desired, a matrix in which the bricks become embedded.

A description of the mechanism in general terms reads thus: It consists of a framework of I-beams, with crossbars to support the gasoline engine. The front I-beam acts as a cutting blade, set a trifle higher than the required height for the finished foundation. To the rear, and attached to rocker arms, is a U-shaped channel iron set with the edges downward. Supported by the opposite ends of the rocker arms, and to the rear of the channel, is an I-beam, 3½ in. wide on its face, which acts as a tamper, consolidating the concrete and finishing the surface. The function of the U-shaped channel-iron is to cut and spade the concrete, thus removing all air holes and voids. The completed surface

SMALL MIXER AND METHOD OF LAYING CONCRETE GUTTER

ready for the bricklayer is thus perfectly smooth and of such firmness that it can be walked upon without injury.

Brick delivered by roller conveyors were placed immediately by hand upon this surface and rolled with a hand roller weighing about 800 lb. This roller was 30 in. wide and 24 in. high. Such a roller will be sufficient to roll the brick to a uniform surface in most cases, but, if desired, the weight may be increased by loading.

Cement grout for filling the brick was mixed by hand in a rocker box, and dumped and broomed into the joints immediately after the bricks had been rolled. The first coat was followed by a second of somewhat heavier consistency, which was mixed by hand in a box and put on with scoop shovels. As soon as the final application was completed, the pavement was covered with earth, and this protecting covering was wet down to prevent too rapid setting of the filler. This rapid sequence in operation produced a slab which was a one-piece construction.

Cost data and the distribution of the men on the concreting and bricklaying are shown in the accompanying table. The method of operation was to lay the concrete and brick with this entire gang and then use part of the gang for grouting and other work. In other words, part of the gang changed off on the work. The tabulation covers the distribution of the gang while laying the concrete and brick, but the total cost covers a day's work of concreting, bricklaying and grouting.

With this force the contractor was able to lay from 800 to 1236 sq.yd. of monolithic slab per day, which would give a manipulation cost between 18c. and 29c. per square yard, with a probable average of about 25c. The record for one gang for an eight-hour day was 630 lin.ft. of 16- and 18-ft. road, totaling 1236 sq.yd. The record made on this work would seem to indicate that a gang of this size should average about 900 sq.yd. per day. However, considerable time was lost on the templet, so that with faster delivery of concrete the work could be expedited.

After the forms were removed from the monolithic slab and the slab had set sufficiently to bear the small concrete mixer, the shallow concrete gutter was built along one side. With a mixer man and 18 laborers, this gutter was laid at the rate of 1200 lin.ft. per day. The

ITEMIZED MANIPULATION COST OF LAYING

Monolithic Brick Slab Complete, Covering One Day's Work of Eight Hours

Number of Men	Description	Amount
2	Foreman at $5.00 per day	$10.00
22	Shovelers and wheelers at $4.50 per day	99.00
5	Handling cement at $4.50 per day	22.50
4	Brick men at $5.00 per day	20.00
2	Laborers behind mixer at $5.00 per day	10.00
10	Laborers carrying brick at $4.50 per day	45.00
2	Mixer men at $5.00 per day	10.00
1	Roller-man at $5.00 per day	5.00
1	Foreman at $7.50 per day	7.50
	Total cost of gang for 8-hour day	$229.00

contour was obtained by screeding over curved steel partition plates, as shown in the illustration. The cost per lineal foot was about 90 cents.

Those connected with this work, both in the State Highway Department and the contractor's organization, consider that the road was built in record time. From the start of grading to the completion of the slab, it took 92 working days to construct 11.92 miles. During this time weather conditions held up work a number of times. Aside from this, both the mixers did not work the entire 92 days. One worked only 57 days, so that on only 57 days did both work at the same time.

The contract for this work was let to Thomas P. Fitzgerald, Ashtabula, Ohio, at a total cost of $484,000, or $421,000 for the main road construction and $63,000 for the gutter, which was let in a separate contract. The construction was under the supervision of the State Highway Department through the county officials. E. C. Blasser was division engineer in charge for the state while Ray M. Case was county engineer and was directly in charge of the work on the road.

271,542 Tons of Engineer Property Returned

Statistics issued by the War Department Dec. 23 show that the tonnage of Engineer property returned from Europe to the United States by the Army was second in the list covering all of the staff corps or services. The Ordnance Department was first with 422,030 tons (short) or 51% of the total. Next came the Engineer Department, with 271,542 tons, or 32%. All other totals were comparatively small, the Quartermaster Department being third with 37,554 tons, or 5%. The total tonnage for all departments was 837,641.

Heavy Traffic Road Design Places Stress on Drainage

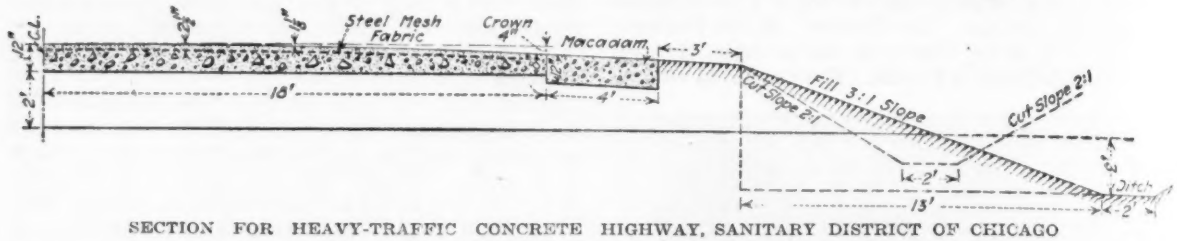
Chicago Sanitary District Seeks Ideal Structure in Fifty-Mile Four-Track Concrete Road—Side Parking Spaces

CONCRETE highways designed for motor-truck traffic of the heaviest character will be constructed practically the full length of the three channels of the Sanitary District of Chicago. Besides the 36-ft. concrete slab, provision is made for 4-ft. macadam and 3-ft. earth shoulders. The roads will thus be 50 ft. wide except in city streets, where an integral curb replaces the shoulders. The 36-ft. slab provides for four lines of traffic, and the shoulders are planned to give space on which trucks can be parked for roadside repairs without obstructing the regular traffic lines.

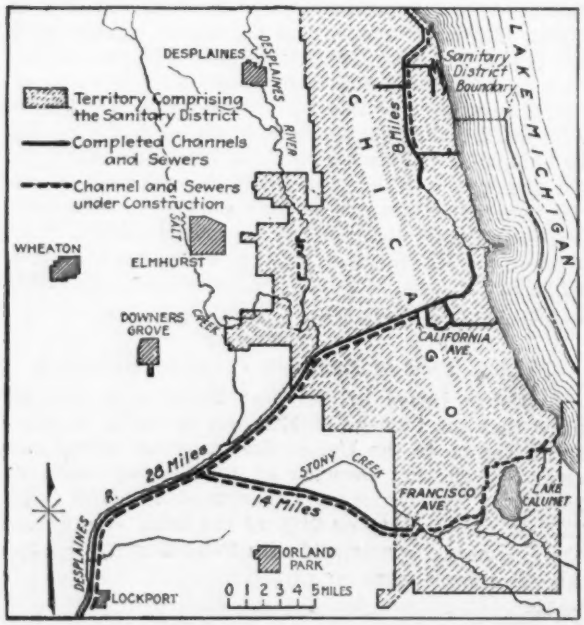
Slab and subgrade construction follows closely the requirements of the specifications of the Division of Highways of Illinois, as outlined in *Engineering News-Record* of Apr. 10, 1919, p. 735. With the dimensions illustrated, a plain concrete slab is calculated to have strength in proportion to the standard designs for 16- and 18-ft. roads of the Division of Highways, but, as insurance, reinforcement has been added. According to the bids received on the eight miles of North Shore Channel road (see map), this reinforcement represents about 4% of the cost.

Besides the care in subgrade preparation, exceptional attention has been given to drainage. The side ditches are large and of unusual depth below the surface of the subgrade. Culverts of reinforced concrete, or vitrified pipe in concrete, connect the side ditches at half-mile intervals. The concrete culverts have 3½ x 3½-ft. openings, and the pipes are 18 in. in diameter. With frequent outlets into the channels, this drainage system is expected to maintain a practically dry foundation for the road.

Bids on the first eight-mile section ranged from $811,431 to $1,130,989, the low bid being a little in excess of $100,000 per mile. Completion of this section by Aug. 1, 1920, is expected. The work will be under the direction of G. M. Wisner, chief engineer, and H. P. Ramey, division engineer, Sanitary District of Chicago.



SECTION FOR HEAVY-TRAFFIC CONCRETE HIGHWAY, SANITARY DISTRICT OF CHICAGO



FIFTY-MILE HIGHWAY SYSTEM OF SANITARY DISTRICT

Development of the Levee System on the Mississippi

Continuous Levees to Restrain Maximum Floods Constitute Present Policy — Design Conditions Are Described

IN THE history of levee protection in the Mississippi Valley, the year 1895 is important as marking the new policy of the Mississippi River Commission which provides for levees of such dimensions as to restrict all floods within the levee lines. Prior to that date the U. S. Government had confined its efforts to strengthening the existing levees. The St. Francis basin of 6000 square miles, in Missouri and Arkansas, had remained unprotected and acted as a reservoir which served to reduce flood heights, but while protection was thus afforded to the lower valley the floods were disastrous to the residents of the basins. Since then a substantial levee line has been constructed along the St. Francis front which will afford adequate protection when work now under contract is completed.

COMPARATIVE SECTIONS OF MISSISSIPPI RIVER LEVEES

This brief statement of the policy for flood control and protection in the Mississippi Valley was given by Col. C. McD. Townsend, Corps of Engineers, U. S. Army, president of the Mississippi River Commission, in an address at the annual meeting of the National Drainage Congress held at St. Louis in November. To illustrate the changed conditions, Col. Townsend exhibited a chart of the comparative cross-sections of the old and present levees at Lake Providence, in Louisiana, where levee construction has had the maximum effect on flood heights. These sections are shown in the accompanying drawing. The cross-sectional areas are 161 sq.

ft. for the levee section of 1882, 530 for that of 1896 and 2158 sq.ft. for that of 1919. The levee of 1882 was about 7 ft. high and contained about 6 cu.yd. per lin.ft. while that of the present standard will average 22 ft. in height and 80 cu.yd. per ft. The increase in flood height from 1882 to 1916 has been 10.4 ft., but while the original levee was below the flood height of 1882 the completed levees of the present standard will be more than 3 ft. above the flood height of 1916.

That the levee section differs materially from that of reservoir embankment was pointed out by Col. Townsend, who explained that this arises from the impracticability of finding in an alluvial valley a foundation impervious to water, which is an essential condition for reservoir construction. Further, material for a puddle core wall is not readily obtainable, nor would such a wall be of great value when resting on a permeable soil. However, the possible value of an impermeable core to prevent saturation of the levee and to keep boring animals from working through it was suggested by a writer in *Engineering News* of June 27, 1912, p. 1236.

In levee construction, the essential conditions are a mound of earth of such height that water cannot flow over its top; of such mass that surfaces of saturation cannot be formed through it on which the superincumbent material will slide, and of such width of base that the water flowing through the permeable foundation will not have sufficient force to remove any material. This mound of earth must be protected from the eroding action of rains and its river surface from erosion by river currents and waves during floods. The grade must be somewhat higher than the highest flood to afford protection against wave action during storms.

Experience with the soils of the Mississippi bottoms has developed certain forms which are of general application to its levees. A slope of 1 on 3, well sodded with Bermuda grass, has been found to resist the action of rain, river currents and minor waves. In localities exposed to the full force of waves through long reaches of river it is necessary either to employ some more permanent forms of revetment, or to adopt a gentler slope. In the Upper Yazoo district concrete has been extensively used for such revetment.

A crown width of 6 to 10 ft. is given generally, being interdependent with the slope on the land side. An 8-ft. crown affords convenient space for patrolling and for storing material to repair damage inflicted by storms. With such width, a land slope of 1 on 2 can be employed until the levee attains a height of 6 ft. In greater heights, unless the soil is specially adapted to levee construction, there is a tendency to form surfaces of saturation through the mass on which the upper portion may slide. Levees not exceeding 12 ft. require a land slope of 1 on 3. With greater heights trouble begins to be experienced with the foundation and still gentler slopes are necessary, or the same results may be attained by adding to the base a mound of earth termed a banquette which is generally 20 to 40 ft. in width, depending on the height of levee.

While these levee sections have resulted from practical experience rather than from theoretical considerations, it may be noted that the sections most generally employed in recent years insure an angle of repose of dry earth on wet clay of 14° when water is at the top of the levee. This is the limiting angle for such materials. European levees have in general a greater width of crown and steeper land slopes, with about the same width of base, but those levees are frequently used for roads.

A continuous levee line did not exist in any district on the Mississippi in 1882, due to the crevasses which had occurred. The total length was about 1000 miles, which had increased to 1680 miles in 1919. The area of the basins protected is 27,116 square miles, but at the lower ends of several of the basins the lands are subject to overflow by backwater flowing around the ends of the levee systems, the area thus flooded in 1916 being reported as 2566 square miles.

The levee line has now attained such dimensions as to afford reasonable security against all but the greatest floods, said Col. Townsend, and it offers a fighting chance of success even with such floods as those of 1912 and 1913. Eternal vigilance is necessary, as a muskrat or other burrowing animal can cause the destruction of the best embankment, if the damage done is not repaired promptly. In 1916, from Sunflower Landing to Natchez, 348 miles, the river rose to the greatest heights on record, but only one crevasse occurred in the levee line along the Mississippi River, which flooded an area of 818 square miles. Breaks, however, occurred in the levee line along the Arkansas river, which inundated about 2,250 square miles of the Upper Tensas basin by flowing around the head of the Mississippi levee system of that basin. These levees have been placed under the jurisdiction of the Mississippi River Commission.

Protecting Iron and Steel Standpipes From Corrosion*

By Charles W. Sherman
Of Metcalf & Eddy, Consulting Engineers, Boston, Mass.

THE proper maintenance of an iron or steel standpipe involves periodic painting to prevent corrosion. The protection of the exterior surface involves no particular problem. The interior surface is, however, difficult to protect, being constantly in contact with water. Moreover, it can be inspected only at intervals and with some difficulty, and it is often hard or impossible to leave the standpipe empty for a sufficiently long period to clean and paint the surface in the most desirable way.

In an attempt to bring together such information as may be obtainable, relative to actual experience with standpipe paints, Metcalf & Eddy sent inquiries to water-works in the Northern and Eastern parts of the United States, requesting information as to the dates of painting, kind of paint used, preparation of the surface for painting, and other significant data.

The data obtained are not susceptible of being summarized or averaged. In a few cases the standpipe has not been painted since erection. There are doubtless cases in which the quality of the water is such that it protects rather than corrodes the metal. Such cases are, however, rare, and experience seems to indicate that as a rule an iron or steel standpipe should be thoroughly cleaned and painted inside, at least as often as once in four or five years. Perhaps, however, if the cleaning were as thorough as would be accomplished by means of the sandblast, and if a protective coating were then properly applied, the interval between paintings could be materially extended.

*Abstract of paper read before New England Waterworks Association.

A. H. Kneen, of Philadelphia, painted two standpipes with vertical stripes of different kinds of paint, and observed the conditions after two or three years of service. The only paints which gave reasonably good service were a red oxide of iron paint, and red lead.

The engineers of the Metropolitan Water-Works have adopted the policy of cleaning the steel by sandblast, and applying three coats of red lead to the interior surface of their steel standpipes. The following quotation from the 15th annual report of the Metropolitan Water and Sewerage Board describes the cleaning and painting of the Bellevue Hill standpipe.

On Mar. 25 the tank was taken out of service and drained, and the work of sandblasting and painting the steel was begun Mar. 30 by the W. L. Waples Co., Boston, subcontractor for this work. The plant used consisted at first of a 20-hp. gasoline engine driven air compressor, a compressed-air reservoir, two lines of air hose and two nozzles. Sandblasting was stopped in the latter part of the afternoon of each day, and the cleaned surfaces were painted before rusting commenced. The force employed included one foreman, two painters, who also did sandblasting, and one helper. This force could sandblast and paint an area of about 330 sq.ft. per day. Later, in order to increase the rate of progress, a second compressor, operated by an automobile engine, was installed Apr. 19. The entire inside and outside surface of the tank, having an area of 35,650 sq.ft., was sandblasted and painted. Work was completed June 14, with the exception of the third coat on the outside, which has been deferred until after the masonry tower which incloses the tank is completed. All painting materials were furnished by the department, but were mixed by the contractor under the direction of the engineer. For the inside of the tank, National Lead Co.'s red lead in oil paste, litharge, and Spencer-Kellogg & Son's boiled linseed oil were used; the first coat natural color, the second and third coats tinted with lampblack in oil. For the outside of the tank, red-lead paste, raw linseed oil, and drier were used for the first coat, and for the second coat white lead, raw linseed oil, turpentine, and drier tinted with lampblack were used. One gallon of red-lead paint was sufficient to cover 700 sq.ft. of surface with one coat. The subcontractor's price for sandblasting and painting the tank was $1600. . . .

The writer inclines to the opinion that the method just quoted represents the best practice of the present time. He would put especial emphasis on the thorough cleaning of the metal, and the *immediate* application of the paint to the cleaned metal before the latter has cooled and moisture has condensed upon it.

With regard to the coating to be applied to the metal after cleaning, it appears probable that not only red lead, but several of the graphite and red oxide of iron paints, and perhaps certain enamel-like coatings, will give satisfactory protection. It has been used for many years for painting the bottoms of steel and iron ships, and has given the best satisfaction of any paint used for that purpose. No other substance has been put to such severe trial and shown so good results; but unfortunately the use on standpipes has been comparatively limited, probably because of a lurking though unfounded fear of lead poisoning if the water remains in contact with red-lead paint.

It is, obviously, unfortunate that the data available are so fragmentary and inconclusive. It is to be hoped that the superintendents having charge of iron and steel standpipes will realize the necessity for more definite information and will make careful record of all the conditions affecting the durability of standpipe coatings, and that at some future time it may be possible to bring the data together and draw positive conclusions.

Motor Trucks and the Postal Service

THAT the United States Postal Service can be utilized to advantage in the transportation of foodstuffs and farm produce from producing centers to consumption points is indicated in figures recently made public by James I. Blakslee, Fourth Assistant Postmaster General, in a bulletin published by the Highway Industries Association of Washington, D. C. Mr. Blakslee after urging greater production of foodstuffs, asserts that three obstacles, none of which is insurmountable, present themselves to the efficient transportation of farm produce with the aid of the Postal Service. These obstacles are the highways, the vehicle, and the postage or freight rate. There are 60,000 employees of the Postal Service who traverse 1,400,000 mi. of highways through producing territory in this country every day. Should each individual carrier transport 2,000 lb. the total transported would amount to 120,000,000 lb. daily, or, assuming the per capita consumption to be 2 lb. daily, enough for 60,000,000 people.

The condition of country highways at the present time makes it impossible, says Mr. Blakslee, to transport a load of one ton on those highways traversed by these employees except in fair weather, and then only with difficulty. Under the present system of compensation it is impossible for 43,000 of the 60,000 carriers to purchase and maintain the character of motor equipment necessary to convey 2,000 lb. of food daily, even for a portion of the year. Also at present the postage rate is too high in proportion to the selling value of many staple articles of food. However, he asserts, with certain obvious improvements the country can considerably reduce its living costs through extensive utilization of the Postal Service. The freight or postage rate could be changed, he says, and classified so that perishable food could be carried at one rate, semi-perishable food for another, and non-perishable at still another. Such rates would be largely governed by the celerity with which movement would have to be accomplished, and the value of the article conveyed.

Past experience offers proof of the immense saving in transporting farm produce by Postal Service, for Mr. Blakslee asserts that from Aug. 26 to the end of December, 1919, comparison of costs to the consumer of farm produce transported by motor truck with the aid of the Postal Service, and that obtained in local retail markets, showed more than 40 per cent saving to the consumer. The comparison was based upon 48 shipments, including potatoes, eggs, apples, honey, and canteloupes, and the average haul was 192 mi. On the 48 shipments of the various staple articles of foodstuffs, the postal revenue amounted to $1,687.76 and the direct cost of transportation was $1,725.54, indicating a loss in operation of $37.78. However, the consumers paid but $15,188.32 for the 48 shipments when the lowest market price on the same day shipments were delivered showed $21,800.64, or a net saving to the consumers of $6,612.32. As a specific instance, on Nov. 12, 86 crates of eggs—2,580 dozen—were shipped from Warsaw, Va., to Washington, D. C., a distance of 135 mi. The postal patrons or consumers paid $1,625.40 for this produce, which would have cost them at the lowest retail price prevailing in the city on that day $2,012.40, or a net saving of $367. The postal revenue was $54.18 and the postal expenditure $60.94. Thus a loss of approximately $6 to the Postal Service resulted in a net saving to the patrons of the service of $367.

Platte River Bridge Reconstruction, Rock Island Lines

Long Pile Trestle With Girder Channel Spans on Pile Piers With Concrete Caps—Jets Aid Piledriving—Traffic Detoured—Work Done by Railway Forces

IN the rebuilding of the trestle bridge carrying the Chicago, Rock Island & Pacific R.R. across the Platte River, in Nebraska, conditions called for special engineering expedients in both design and construction methods. Work is now actively under way. Diversion of traffic by connecting to the line of another railway makes it possible to carry on the operations economically and conveniently. Pile-bent piers with concrete caps to carry girder-spans, and sheathed pile bents fitted with ice breakers, are prominent features of the design. Very effective use is made of high-pressure water jets to facilitate the driving of piles in deep sand. All of the construction is being

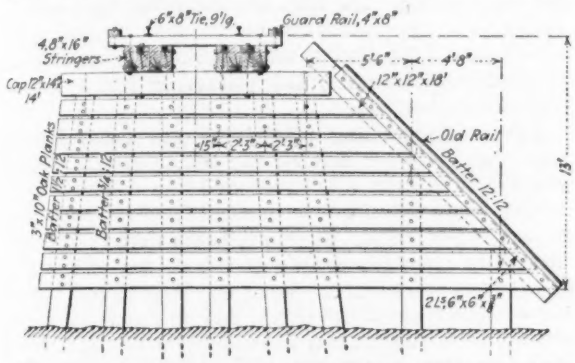


FIG. 1. TRESTLE BENTS ARE SHEATHED AND HAVE ICE BREAKERS

carried out by the force and equipment of the railway's bridge department.

This structure is near South Bend, Neb., on the line between Omaha and Lincoln. It is about 3,000 ft. long and originally was a pile trestle for its entire length. As rebuilt, however, it will have 15 spans of 40-ft. plate girders over the main channel, near the middle of the bridge.

Diversion of traffic was decided on as much cheaper and more convenient under the favoring conditions of the location, than the construction of a temporary trestle. Near the west end of the bridge is a grade crossing of the Chicago, Burlington & Quincy R.R. and a few miles farther southeast this line crosses the Missouri Pacific R.R., which runs north and, in turn, crosses both the river and the Rock Island Lines. By putting in three junction connections a detour was obtained, very little longer than the direct main line. This arrangement was made the more easily from the fact that at the time all railways were under Government control, so that the three lines were practically parts of one system.

The river bed is in a sand formation of unknown depth, except that the middle hardpan is found at a depth of about 25 ft. The sand bed is not uniform but has numerous soft pockets, so that while in places it is hard to get the piles to the required depth, at other places care has to be exercised not to let them go too deep for the length of pile. In all cases, however, as soon as the disturbance due to the water jet is stopped the sand packs tightly around the pile. In fact, if jetting is stopped before the pile is well down it is hard to start the pile again, even by both driving and jetting.

Untreated white oak piles are used, about 45 ft. long and 18 to 20 in. in diameter at the butt, with an average penetration of 38 ft. Untreated Oregon fir is used for the caps and the trestle stringers on account of its cheapness and durability in this climate, together with the high cost and scarcity of large sizes of pine timber. The bents are spaced 15 ft. on centers and are driven between those of the old structure. The depth from rail level to river bed is from 15 to 20 ft. At the center of the river crossing the rail level is raised 3 ft. above that of the old structure so that the new girder spans will be clear of the high-water line, the rails being about 6 ft. above this line. As no change was practicable on the approaches, the elevation is run out by grades of 0.24 per cent and 0.3 per cent on the trestle portions.

Heavy ice conditions make it necessary to provide each bent with an ice breaker and to sheathe the bents with horizontal planks in order to keep ice or drift from lodging between the piles. A five-pile bent is used to support the cap and two additional piles carry the nose of the ice breaker, which is a 12 x 12 in. oak stick having a slope of 1 on 1. This is faced with an old 60-lb. rail fastened by screw spikes. The timber is further protected for its entire length by angles fitting over the edges and fastened by lagscrews on the sides. Typical bent construction is shown in Fig. 1.

For the deck, 9-ft. pine ties 6 x 8 in. are spaced 13 in. on centers and bolted to the stringers. Along the ends are guard timbers 4 x 8 in. laid flat, and not boxed out for the ties, while steel guard rails inside the track are set 8 in. from the track rails. Refuge platforms for watchmen are placed at intervals of 500 ft., being carried on long ties and utilized for the

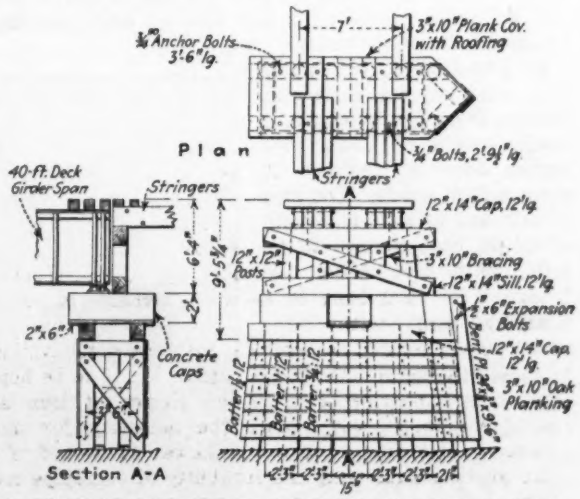


FIG. 2. PILE PIERS WITH CONCRETE CAPS CARRY GIRDER SPANS

usual water barrels provided for fire protection. The piers for the girder spans are concrete-capped double bents, with the two pile rows spaced 3½ ft. on centers; each row consists of six creosoted piles, as shown in Fig. 2. These are stiffened by diagonal bracing; they are sheathed on the outside and have a batter pile for the ice breaker. The nose of the ice breaker is protected by a bent plate which is spiked to the sheathing and pile and secured to the concrete cap by masonry expansion bolts.

Two precast concrete slabs 24 in. thick form the cap of each of these girder piers (Fig. 3). The slab for the upstream end has a triangular nose extending over the ice breaker, while that for the downstream end is recta..gular. They rest directly on the timber caps of the two bents and are bolted to them. A nose slab weighs 9,000 lb., and a rectangular slab 6,000 lb. They were cast at a yard near the bridge, using wood forms and 1:2:4 gravel concrete.

The main reason for adopting the slab-cap construction was the desire to avoid a grillage cap, as would otherwise have been required; an auxiliary reason was the advantage of the slab as a means of

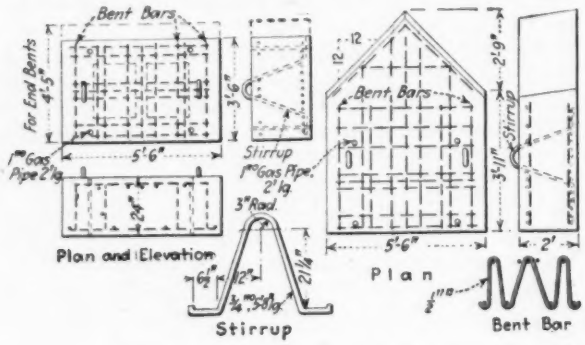


FIG. 3. CONCRETE SLAB PIER CAP

fire protection. In first cost concrete and grillage caps are about equal, but the maintenance of the concrete caps is considerably less. On some structures where this construction has been in use for ten years there has been no maintenance cost. The concrete caps give a good seat for the spans, which rest on shoes anchored to the slab by bolts passing through 1-in. pipe sleeves.

In pile-driving, two water jets are used for each pile. The jet is applied by way of a 50-ft. length of 2½-ft. pipe drawn down at the end to form a 2-in. nozzle. The pipe is attached to a 75-ft. length of 2½-in. hose coupled to an 8-in. main laid along the bridge. On each bank is a pumping plant with three steam pumps (one in reserve) to supply the main. At intervals of 60 ft. are fitted 3-in. tees each having a valve and two horizontal 2½-in. connections for the hose lines. A pressure of about 125 lb. is maintained at the jet or nozzle; the maximum distance from pumping station to piledriver is about 3,000 ft. A gage is placed on the nearest tee connection between the piledriver and the pumps, record being kept of the pressure for each pile.

The upper end of the jet pipe is bent into a loop or gooseneck, and is attached to a line running over the top of the leads and operated by a niggerhead on the piledriver engine. In this way the pipe is readily pulled up as the pile drops into the loosened sand. When the piledriver is run back for material the line is detached and the jet pipe left standing in the sand at the location of the next pile to be driven.

Ordinarily, piledriving is not done when the temperature is below 25 deg. F., as water is likely to freeze in the tee connections and valves. It has been done, however, at a temperature as low as 6 deg. In moderate weather each driver can average 15 piles per 10-hour day. The men are furnished with rubber suits and all pipe joints and connections are kept tight so as to avoid the discomfort of working in wet clothes. In very cold weather, the piledriver crews unload material at the yard.

Two self-propelling piledrivers are used, having swinging leads for driving the batter piles. One is a regular railway piledriver and the other a locomotive crane with leads suspended from the boom and braced to the frame. These machines work in opposite directions from the center of the bridge and Fig. 4 shows them commencing operations. They have a traveling speed of about 15 m.p.h. and are used to bring out the piles and timber, the piledriver crews keeping the carpenter crews supplied with material. The bents, including caps, are completed first, the deck being put on by a separate crew as fast as the bents are driven. All planks and timbers are bored by pneumatic augers operated from the portable compressor of a tracklaying outfit.

For each bent, the two nose piles are driven first and are cut off to carry a working platform for the carpenters who place the cap, ice breaker and sheathing. The carpenters also saw off the old piles about 9 ft. below the deck, the ends being then split up for use as posts. This cutting is done by crosscut saws, the men working on floats or scaffolds where necessary, but in many places the men can work on dry ground during low water. These white oak piles, 18

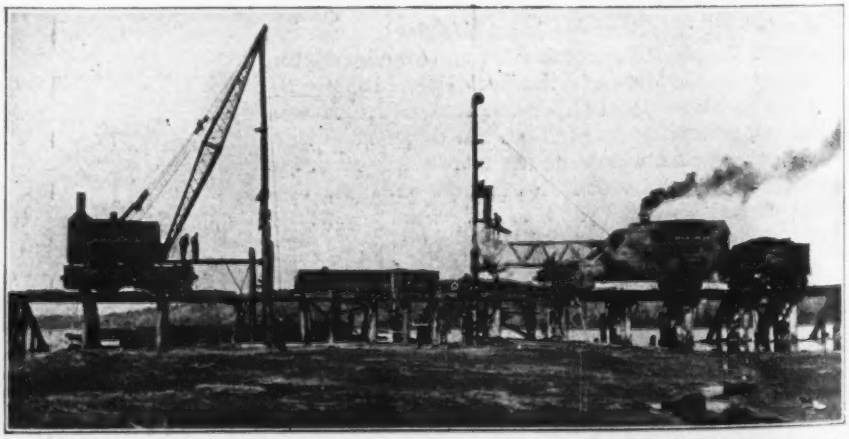


FIG. 4. PILEDRIVERS AT WORK ON PLATTE RIVER BRIDGE RECONSTRUCTION

years old, are perfectly sound except near the water line, where they are badly rotted.

In removing the old deck, the ties and stringers are picked up in bundles by the piledrivers or a locomotive crane and carried back to the material yards at each end of the bridge. The drift bolts are removed by jacks or claw bars to enable the caps to be pulled up. After the completion of the new bridge it is proposed to remove the lower parts of the old piles by the aid of the water jets.

Salvage of material from the old bridge is receiving special attention, in order to reduce to a minimum the loss which normally accompanies work of this kind. All timber and metalwork is accounted for and shipped to the store department. Orders are given that all washers, bolts and similar metal must be saved. While some loss is inevitable, the fact that account

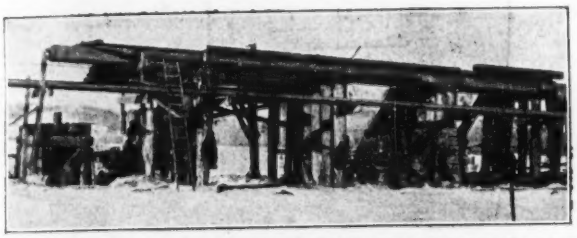


FIG. 5. WORKING FROM THE ICE IN SHEATHING ONE OF THE NEW BENTS

is kept of the salvage is sufficient to make a foreman careful to see that the loss is as small as possible. None of the old material is used on the new work, but all is sent to the store department, where it is worked over and supplied for other work on requisition. This department has a salvage plant where, among other things, bent bolts are straightened, headed and rethreaded, thus making them into practically new bolts at small expense.

This reconstruction was commenced in October, 1919, and is expected to be completed by next May. It is being done by the bridge department of the railroad, with a force averaging 60 men who are housed at a camp near the material yard on the south side of the river. The work is in charge of T. A. Smith, resident engineer, and is under the direct supervision of I. L. Simmons, bridge engineer of the Rock Island Lines. C. A. Morse is chief engineer.

Water Supplies from the National Forests

About 1,300 municipalities obtain all or a part of their water supplies from drainage areas lying within the national forests, according to a letter from the Secretary of Agriculture to the House of Representatives, in connection with an inquiry as to expenditures pertaining to public health. The letter states that it is the practice of the Department to co-operate as far as possible with these municipalities in the protection of the sanitary quality of the water drawn from forest areas. In some cases the Department approves regulations of local health boards for the protection of water supplies, and the regular forest force co-operates in the enforcement of these regulations. Where special patrol forces are required they are provided and paid for by the municipalities benefited, but are under the general supervision of local forest officers.

Feeding Garbage to Hogs at St. Paul

GARBAGE disposal by feeding to hogs under three contracts for as many districts is being continued at St. Paul, Minn. On the whole, the contracts for service beginning Sept. 1, 1919, were not as favorable to the city as they were for the previous year.

In 1918-19 the city collectors were paid $130 per month, but they furnished teams and running gear and the city supplied metal wagon boxes. The collection cost the city $52,655 in 1918-19, according to the report for that year of M. N. Goss, commissioner of public works, but that figure included $6,000 for inspection service. The city had 30 teams on garbage collection in 1918-1919 and three on dead animals. In addition, there were 50 licensed collectors taking garbage from hotels, restaurants and apartments. These paid a license fee of $5 a year and were under city inspection. The garbage they collect is all fed to hogs, but what the collectors pay to hotel keepers for the garbage is not known by the city authorities.

During 1918 a total of 5,728 tons of garbage were collected by the city and approximately 9,432 by private collectors, or a total collection of 15,108 tons. The city received $11,147 for the garbage collected by it, $1,227 for hides and dead animals, and $250 for license fees from private collectors, making a total revenue of $12,624 for the year against $52,665 expense. The cost of collection includes repairs to the equipment owned by the city, but no interest or depreciation.

For a number of years garbage collected by the City of St. Paul was delivered to stock feeders just outside the city limits at their own prices, and it was claimed that there was difficulty in disposing of all the garbage collected in that way when 25c. per ton was the average price. In August, 1914, the function of collecting garbage was transferred from the Department of Health to the Department of Public Works (a charter provision under the new commission form of government) and arrangements were then made for disposing of the garbage on the following basis: District 1, with 17 teams collecting, delivery just north of the central part of the city, at 80c. per ton. District 2, with 7 teams collecting, 80c. per ton to be delivered just north of the north city limits, and District 3, with four teams collecting, 75c. per load to be delivered on the south band of the river. In 1917, new contracts were made with the same parties on a basis of $1 a ton. In 1918, some publicity was given by the city as to the garbage to be disposed of by advertising for bids. Nine bidders appeared and contracts were awarded as follows: District 1, $3.02 per ton; District 2, $3.27 per ton and District 3, $1.38 per load (approximately $2 per ton) with contracts running to Sept. 1, 1919. Contract prices for 1919-20 are: District 1, $1.75 per ton; District 2, $2.60 per ton and District 3, $3.25 per ton.

An interesting situation developed here in that the high bids received were as follows; District 1, $2.52; District 2, $3.60 and District 3, $3.25. On being awarded the contracts the high bidder of District 1 withdrew his bid and forfeited his bond of $250, claiming that his plans for disposing of the garbage had miscarried. This left the 1918 contractor the high bidder. The high bidder in District 2 then claimed he had made an error and that it should read $2.60 instead of $3.60 which still left him the high bidder. In the third district there were two bidders, the man who

had it last year at $1.38 bid 95c. and the man who had the contract in 1917 bid $3.25 and took the contract.

According to local opinion, there is little question that there was a dummy bidder in District 1 to protect the situation for the existing contractor, and that in District 2 anticipated competition did not materialize, and that in District 3 the contractor is paying about what the garbage is really worth. On the whole these contracts are not quite as favorable as they were for the year 1918-19.

1920 Program Shows New York Highways 67½ Per Cent Concrete

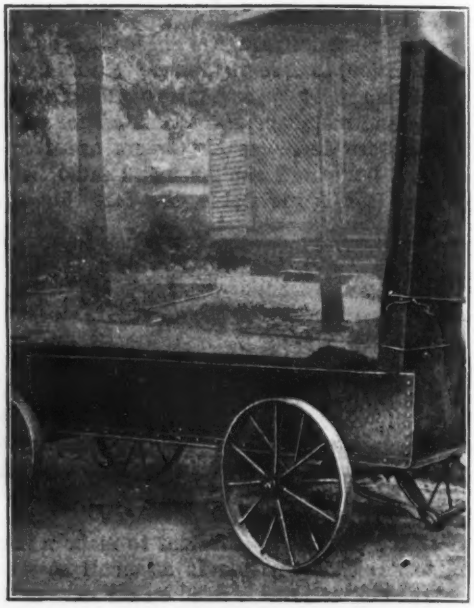
EXAMINATION of the figures recently issued from the New York State Highway Department giving a tentative program for 1920 construction shows that, out of a total of 725 mi. to be laid this year, approximately 500 mi., or 67½ per cent of the total, are listed as concrete highways. Bituminous macadam is second with 139 mi. and 38 mi. are to be constructed of one or both of the foregoing types, though no final determination as to which type will be used has yet been made. As this 38 mi. comprises numerous short pieces of road it is presumed that about half will be constructed of each type.

The following table, containing a distribution of proposed construction classified as to length and type and county, is compiled from figures furnished by the State Highway Department, which figures are subject to change according to Commissioner Greene:

		Mileage and Type				
	County	Concrete	Bituminous Macadam	As Designed	Dual Type	Asphalt Block
1	Albany	12.79	.....	.....	.....	.....
2	Allegheny	4.85	.....	.....	.....	.....
3	Broome	17.28	6.00	.....	.....	.....
4	Cattaraugus	21.04	.....	.....	.....	.....
5	Cayuga	8.30	.....	.....	.....	.....
6	Chatauqua	21.24	.....	.....	.....	.....
7	Chemung	4.55	.....	.....	.....	.....
8	Chenango	.....	9.92	.....	.....	.....
9	Clinton	5.50	9.20	.....	.....	.....
10	Columbia	11.62	.....	.....	.....	.....
11	Cortland	6.54	2.50	.....	.....	.....
12	Delaware	13.50	6.00	.....	.....	.....
13	Dutchess	7.23	.....	.....	.....	.....
14	Erie	23.77	.....	.....	.....	.....
15	Essex	6.00	.....	.....	.....	.....
16	Franklin	.....	6.03	.....	.....	.....
17	Fulton	1.10	.....	.....	.....	.....
18	Genesee	3.50	.....	.....	.....	.....
19	Greene	.....	6.06	.....	.....	.....
20	Hamilton	.....	3.00	.....	.....	.....
21	Herkimer	8.86	.....	.....	.....	.....
22	Jefferson	15.76	.....	.....	.....	.....
23	Lewis	.....	4.74	.....	.....	.....
24	Livingston	10.34	.....	.....	.....	.....
25	Madison	6.85	.....	.....	.....	.....
26	Monroe	7.69	.....	.....	.....	.....
27	Montgomery	8.13	.....	.....	.....	.....
28	Nassau	15.65	0.40	.....	.....	.....
29	Niagara	2.38	.....	3.00	.....	.....
30	Oneida	9.20	.....	.....	10.40	.....
31	Onondaga	0.22	6.55	.....	.....	.....
32	Ontario	7.80	.....	.....	.....	.....
33	Orange	21.29	.....	.....	.....	.....
34	Orleans	6.92	.....	.....	.....	.....
35	Oswego	10.16	11.01	.....	.....	.....
36	Otsego	7.83	.....	.....	.....	.....
37	Rensselaer	9.10	.....	.....	.....	.....
38	Rockland	12.49	.....	.....	.....	.....
39	St. Lawrence	8.24	11.16	.....	.....	.....
40	Saratoga	18.17	6.10	.....	.....	.....
41	Schenectady	3.90	.....	.....	3.42	.....
42	Schoharie	10.50	10.82	.....	.....	.....
43	Schuyler	2.95	.....	.....	.....	.....
44	Seneca	13.50	.....	.....	.....	.....
45	Steuben	6.40	7.57	10.00	.....	.....
46	Suffolk	3.00	.....	.....	.....	.....
47	Sullivan	5.69	.....	.....	.....	.....
48	Tioga	13.35	.....	5.50	.....	.....
49	Tompkins	5.10	.....	.....	.....	.....
50	Ulster	22.25	14.33	.....	.....	.....
51	Warren	4.85	5.13	.....	.....	.....
52	Washington	13.20	.....	6.98	.....	.....
53	Wayne	14.30	.....	.....	.....	.....
54	Westchester	9.85	5.72	.....	.....	1.23
55	Wyoming	7.29	.....	6.99	.....	.....
56	Yates	.....	6.86	9.63	.....	.....
	Total	492.02	139.12	42.10	13.82	1.23

Utilizing Old Material for Bituminous-Pavement Repairs

DURING the past three years all asphalt and other bituminous pavement surfaces in Birmingham, Ala., have been maintained by cutting out bad spots, melting the material in a portable heater, painting the edges of the cut, then replacing, tamping and smoothing the heated material. The upright at the end of the heater shown in the view serves as a chimney for the firebox at the bottom of the wagon body. The 25% or so of material lost in the cutting and heating has been made up from the waste dumps at three privately owned asphalt plants.



HEATER FOR BITUMINOUS PAVEMENT REPAIRS

The same method is followed where cuts in the pavements are made for utility or other purposes. This kind of maintenance work was formerly left undone until it could be carried on by one of the paving companies. In round numbers, 1,000,000 yd. of bituminous pavements of all classes have been maintained by the method outlined. Julian W. Kendrick is city engineer of Birmingham.

Figures on French Reconstruction

The magnitude of the reconstruction task confronting the French Minister of the Liberated Regions is indicated in the following figures given out by M. Labbe, Director General of Technical Services, and published recently in *Commerce Reports*:

Building work alone would require 22,000,000 tons of material and the labor of 700,000 persons for one year; 100,000 houses are to be entirely rebuilt, requiring 5,000,000,000 bricks, 3,000,000 cu.m. of sand, 1,000,000 tons of lime, 13,000,000 sq.m. of tiles and 3,000,000 cu.m. of wood. Reconstruction of highways and railroads would require 3,000,000 tons of material and the labor of 15,000 men for one year. In addition, 20,000 trains and 5000 trucks would be required.

Sulphur and Phosphorus in Steel To Be Investigated

Large Committee Organized for Work — Project Due to Commercial Conditions and Doubt as to Present Restrictions

RESEARCH work on a large scale has just been started by a joint committee of steel-producing and steel-consuming interests, formed to investigate the effect of phosphorus and sulphur on the qualities of steel. Indirectly the work is the outcome of war conditions. Difficulties in adhering to the ordinary specified limitations on sulphur and phosphorus content, especially in the matter of sulphur, whose percentage is increased by the extensive use of coal as fuel in place of natural gas, led to a practical suspension of the normal specification limits on sulphur and phosphorus during the war. By action of the American Society for Testing Materials in 1918 the limit for sulphur in all steels and for phosphorus in acid steels was raised 0.01 per cent. In June, 1919, the original limits were restored for special steels, spring and forging steels, and the like, and it has been expected that the old limits for other steels would be restored in 1920. In the meantime, however, the society's steel committee came to the conclusion that definite test data as to the real extent of the presumed harmful influence of phosphorus and sulphur are lacking, and that such data should be obtained and made the basis of future specifying. Consultation with the U. S. Railroad Administration and with the Bureau of Standards then led to the organization of a joint committee to study the subject. This committee includes:

G. K. Burgess and H. L. Whittemore, Bureau of Standards; F. M. Waring and H. E. Smith, U. S. Railroad Administration; R. W. Hunt & Co. and T. D. Lynch, American Society for Testing Materials; F. P. Gilligan, Society of Automotive Engineers; E. F. Kenney and J. J. Shuman, Association of American Steel Manufacturers; J. E. McCauley, Steel Founders' Society of America; F. C. Langenberg, War Department; D. J. McAdam, Navy Department; Frank Gentles, Shipping Board; J. H. Hall, National Research Council. The committee is headed by Dr. George K. Burgess, of the Bureau of Standards. C. L. Warwick, secretary of the American Society for Testing Materials, is secretary.

While the influence of phosphorus and sulphur upon the quality of steel has been under observation in practice and under study in laboratories for many decades, strong differences of opinion have always existed as to the point at which these two ingredients become harmful to the material in different services and in different grades of hardness. For this reason, it has been concluded, a systematic attack on the question by tests of a large series of steels, in which only one factor is varied at a time, will throw entirely new light on the question.

Parts that have failed in service will be studied with respect to composition, so that if there is any recognizable systematic effect of sulphur and phosphorus percentage upon quality of material it may be discovered. Entirely separate from this, a program of tests on specially made samples of steels of various sulphur and phosphorus percentages will be carried out. This test campaign in itself will be in two parts, of which one includes material from very low up to moderate sulphur and phosphorus percentages, while the other includes steels of abnormally high percentages. For the former series the rule has been adopted that all sulphur must be "residual" sulphur, that is, sulphur present in the steel from the fuel or from the raw materials. The second part of the test program will cover steels of abnormally high sulphur, higher than can be obtained as "residual" sulphur.

Work is being begun on the soft steels of the first half of the program (Series A). According to present plans Series A will embrace the range of steels listed below:

SERIES A TESTS, SULPHUR AND PHOSPHORUS RESEARCH

Group No.	Material	Carbon	Manganese	Phosphorus*	Sulphur *
1	Rivet steel, tubes, etc.	6–12	35–40	2–3	3–4
				4–5	5–6
				6–7	7–8
2	Plates and structural shapes, including boiler plate	16–22	35–40	3–4	3–4
				5–6	5–6
				7–8	7–8
3	Forgings, such as car axles, treated and untreated	45–55	50–60	3–4	3–4
				5 6	5 6
				7–8	7–8
4	Wheel, tire and rail steel	65–75	60–70	3–4	3–4
				5–6	5–6
				7–8	7–8
5	Spring steels	95–105	35–45	2–3	3–4
				4–5	5–6
				6–7	7–8
6	Castings	Compositions to be considered later.			

Sulphur in all steels to be "residual sulphur."
All compositions are expressed in hundredths of per cents.
* With each of the specified ranges of phosphorus it is understood that the sulphur content is to be constant and equal to the usual value for that group of material; vice versa for sulphur.

Laboratory, fabricating and service tests will be carried out; in the laboratory, mechanical tests of various kinds will be applied, including impact and endurance tests where possible. The amount and kinds of gases present in the steels under test will be determined. Most of the testing is to be done at Watertown Arsenal, the Annapolis experiment station of the Navy, and the Bureau of Standards.

A number of tons of rivet steel have been manufactured for the tests. After grading, about a ton of material in each grade will be obtained, half to be subjected to test and the rest held in reserve for check. This material falls under Group 1 of the Series A tests. A beginning has been made in the Series B tests by arranging with a large steel company for the manufacture of three heats of steel, covering plate and structural, forging, and wheel, tire and rail grades. From each of these, eight ingots will be poured, to obtain sulphur content varying from 0.04 up to 0.15 per cent, by the addition of sulphur or pyrites in the pouring.

An unusual degree of co-operation has been realized in the undertaking. Steel manufacturers are heartily in accord with the aims of the committee, and will contribute material and assistance. Government departments, manufacturers and railroads have offered test facilities and materials. There is at present no expectation that it will be necessary to raise a separate fund for carrying on the work. The committee invites the support of all persons and organizations interested in the work, and will welcome any information that might prove of value in planning or carrying out the tests.

Department of Health for South Africa

A Department of Health for the Union of South Africa was created by legislative enactment in 1919 and Thomas Watt was appointed as Minister of Public Health. Of the nine chapters of the act, one relates to public water supplies, meat, milk and other articles of food, and another to sanitation and housing. Particulars regarding the act are given in a brief summary published in *Public Health Reports* (Washington, D. C.) for Jan. 9, 1920.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Engineering and Adventure

Sir—I was very much pleased with the article by Prof. P. B. McDonald, "Engineering and Adventure," which appeared in your issue of Jan. 1, p. 17. I have always held that the principal cause of low salaries and lack of appreciation of which engineers complain, were due primarily, to too great emphasis placed by engineers on the side of their work which dealt with materials, etc., and not enough value given to the human equation. In other words, they fail to appreciate that the "Greatest study of mankind is man." Our friends the lawyers, do not make this mistake and the general complaint is that *their* profession receives too much recognition.

T. FRANK QUILTY,
Chicago. President Superior Stone Co.

Legislative Prospects Good For Public Works Department Bill

Sir—The technical men of the country will appreciate the report of the first convention of the Public Works Department Association contained in your issue of Jan. 22, 1920, and especially that portion relating to the necessity for financial support. It is suggested, however, that your comments do not give as favorable an impression of the legislative prospects as they deserve, and the writer submits for the information of the engineering profession a short statement in response to two sentences thereof. These sentences, beginning at the bottom of page 169, are as follows:

"It (the Jones-Reavis bill) apparently has not been seriously considered by either of the committees nor was there a definite prospect of hearings on it. One of the results of the convention—and particularly of the calls made by delegates on Congressmen—will probably be the resurrection of the bill from committee and early consideration through hearings."

Your representative did not take sufficient notice of that part of the report of the Executive Committee relating to the present status of the campaign, viz:

"The public works bill was introduced on June 25, 1919, many months before it could be expected to secure any consideration by Congress. The purpose of this early introduction was to give the measure an official status so that our work could be focused on a definite proposal embraced in an officially inscribed instrument. Immediately after the bill was introduced request was made to the chairman of the House and Senate committees to which the bill was referred, that it be not acted upon during the special session of Congress and that nothing be done with it until about Jan. 1, 1920. The chairmen of both committees have graciously complied with this request. We asked for this seven months' period of inaction to prosecute the campaign of education among our member organizations and others."

The writer is pleased to state that, so far, the progress of the public works bill conforms almost precisely to the campaign schedule originally set down by the Executive Committee of the Association. The engineers of the country will be interested to know that, a few days after our public works convention, one of the leaders of Congress stated that the legislative progress of the Jones-Reavis bill, its appeal to the members of Congress, and the rapidly growing sentiment in favor thereof, constitutes one of the most remarkable events in his extended Congressional experience.

The engineers of the country may be assured that while there is much to be desired concerning the financial features of the campaign, the legislative aspects are far more favorable at this date than was really expected by those who have been most conversant with the situation.

M. O. LEIGHTON,
Chairman National Public Works Department Assn.
Washington, D. C.

"They Soaked Us When They Had the Chance"

Sir—In his inland water transportation discussion, Mr. Baker says: "The railways at the present time, instead of charging extortionate rates for their service, are not charging enough to save themselves from bankruptcy," and "the railway can reduce its rates below cost, if necessary, to meet a boat's competition and can raise them again after the boat has been taken off. The railway need not necessarily lower its rates to do this. If a line of boats begins operating on a river, the railway can start a competing boat line and lose money on it, if necessary, long enough to put the other line of boats out of business. Such things have been done."

Does it never occur to financial kings, railway men and engineers to put the two facts together and thus learn the reason for the attitude of the public toward railways? They "soaked" us when they had the chance and now we are getting even. It is a great game if you don't weaken and at the present writing the public is going strong. It can be said that the public does not know what is good for it, but neither did the railroads know when they were well off.

R. H. BLAIN.
Easton, Md.

[The fact that some railroad managements have been high-handed is not good and sufficient reason to adopt a policy of general railroad "soaking," and it will be noted that Mr. Blain questions the desirability of such a policy for the public's good. If the railroads are so restricted that needed development cannot take place, business in general and the public will suffer as well.—EDITOR.]

Waterways and Railroads

Sir—In Mr. Baker's study of inland waterways he has discovered some interesting facts regarding the comparative costs of the New York Canal, and the New York Central Railroad which it parallels and competes with and also of the proposed Lake Erie and Ohio River Canal and the Pittsburgh, Youngstown and Ashtabula Railroad which that canal will practically parallel if it ever should be constructed.

According to the report of the State Comptroller for the year ending June 30, 1918, the cost of the New York Canal during the fourteen years from 1905, when the work on the new canal was begun, for bond interest, construction, maintenance, repairs and sinking fund charges, has been paid $250,504,684.52.

According to Poor's Railroad Manual for 1906, the cost of the entire 808.64 miles of the New York Central Railroad System in 1905, including equipment, was

$198,479,248, or an average cost per mile of $245,448. At this rate per mile the cost of the 296·5 miles from Albany to Buffalo would be $72,775,332, and for the 438.72 miles from New York to Buffalo, the cost would be $107,682,946.

These figures mean that the State of New York has constructed a canal, without providing any equipment for barges and towboats, that has cost the taxpayers since 1904 almost three and one-half times what the railroad it would compete with had cost for equipment from Albany to Buffalo, and almost two and one-half times the cost of the railroad from New York to Buffalo.

According to Poor's Manual for 1918, the 137.6 miles owned by the Pittsburgh, Youngstown and Ashtabula Railroad cost, including equipment $21,739,729, or $138,838 per mile, while the estimated cost of Lake Erie and Ohio River Canal, 101.5 miles in length, according to the Report of the Canal Board for 1917, without the Warren and New Castle branches, is $64,625,400, or $639,624 per mile, without any equipment, or over four and one-half times the average cost per mile, which it would practically parallel, including equipment, and with which it would compete.

In view of the figures given above, when it is considered that the canals will be open for operation, according to the experience with the old Erie Canal, not over seven months per year, the writer believes as an economic proposition, it would have paid the State of New York to have abandoned the Erie Canal entirely and to have invested the $250,504,684, which it has cost from 1905 to 1918 inclusive, in 4 per cent bonds, and to use the interest in paying the railroads for carrying the 10,000,000 tons which is the estimated capacity of the new and enlarged canal. If this had been done, the State would have assets that could have been converted into cash, at any time, instead of having on its hands a canal that will be a source of expense as long as freight is transported free of tolls.

With regard to the Lake Erie and Ohio River Canal which its advocates propose shall be built by the National Government at a cost over four and one-half times that of the railroad which it would parallel and compete with, the writer would be glad to have any advocate of water transportation show how, when taking into account interest on the cost, operating and maintenance charges, to say nothing as to sinking fund charges if the Government should build the canal from the sale of bonds, freight could be transported on it, at less cost than by a railroad which it would parallel, the cost of which including its equipment, was less than one fourth that of the canal without equipment. W. G. WILKINS.

Pittsburgh.

Why Not Engineers on Industrial Committee?

Sir—I was very much interested in the letter of W. M. Butts in your issue of Jan. 1, p. 53, entitled "Why Not Engineers on Industrial Committee?" I recently wrote a Senator and Representative for both Kansas and Colorado on this subject. Extracts from their replies might be of interest:

Of course you understand that practically all of these commissions are appointed by some member of the Cabinet under the direction of the President and it is, therefore, impossible for Congress to indicate specifically the personnel of such commissions. These positions are to some extent political in their nature and if technical work is required, such experts are generally employed by the commissioners.

I think your suggestion that the service of engineers should be utilized in connection with the work of various commissions, etc., is good. I shall be glad to render any help I can looking to the extension of such recognition. I am glad to hear from you, and appreciate your calling my attention to the matter about which you wrote. I certainly agree with you that engineers should be recognized on these industrial commissions.

The fact that for the numerous commissions which have been created mechanical and electrical engineers have not been considered had escaped my notice. Why this should be the case when industrial developments of all kinds require the services of this character of men I cannot understand, and why in the personnel of these commissions these engineers should not have consideration. I assure you I would be glad to have this in mind and should opportunity offer would be glad to aid in any way possible to have proper consideration in this connection for positions they would be so well qualified to fill.

According to these Congressmen the difficulty seems to be not in the ability of the engineer to serve but in the oversight of the "powers that be" in utilizing such ability. J. B. MARCELLUS,

Boulder, Col. Civil Engineer.

What the New York State Barge Canal Has Cost the Taxpayers

Sir—In connection with Mr. Baker's article on the "Future of Inland Water Transportation," it would be interesting to know whether the cost of interest during construction has been included in the $155,000,000 spent by the State of New York on its canals during the last twenty years. Although it is not customary, I believe the true cost of this item should be found by compounding. In case of a project covering so long a time any other method results in a gross underestimate of the real cost. EDWARD GRAY,

Richmond, Va. Chesapeake & Ohio Railroad.

[The interest was not included, although it should be, of course, to obtain the total cost. The figures quoted in the letter which follows show the size of the burden which the New York canals place upon its taxpayers.—EDITOR.]

Sir—I am very glad to see that you have taken up the question of water transportation in an unbiased study of the subject. I have already gone on record in published letters and pamphlets in relation to the proposed Lake Erie and Ohio River Canal, stating conclusions not only as regards that particular project, but on the general subject, which agree with the opinions expressed in your first article.

From the figures given in the "Report of the Comptroller of the State of New York on the Expenditures of the Canals for the year ending June 30th, 1918" some interesting deductions can be made with regard to the New York Barge Canal. The report contains two tabulations, one giving the yearly expenditures for the canals from 1817, when construction on the canal from Albany to Buffalo was begun, down to and including June 30th, 1918, and the other, the annual receipts during the same period.

The total expenditures have been $561,738,242, and after deducting operating receipts, interest on bank deposits, interest on investments, sales of land, etc., amounting to $163,328,450, the net cost to the taxpayers up to the above date has been $398,409,792.

If this last sum had been invested in bonds bearing only four per cent interest, the State would have received annually $15,936,391.38, but as it has been invested

in the canals, on which no tolls are charged, it is indirectly costing the taxpayers the last mentioned amount every year.

This sum which the State might under the above conditions have received, would have been sufficient to have paid the railroads for transporting the ten million tons which the State Engineer says the canal could have carried in 1918.

The State would also have been relieved from paying the sums that it has cost every year, for construction, supervision, repairs and bond charges, which for the last twenty years have averaged over thirteen million dollars a year.

The State would also have had assets to the amount invested in the bonds, which could have been realized upon, instead of a canal system which has been, and probably always will be, a source of expense instead of revenue.

W. G. WILKINS,
Pittsburgh, Pa. The W. G. Wilkins Co.

Engineering Fees Not Excessive in Government Housing

Sir—Fees for engineering service paid by the United States Housing Corporation have been criticised as excessive in a recent report made by the Senate Committee on Public Buildings and Grounds. Exception is made to the report of the former chief to the effect that the "Average fees and overhead allowance has been but 1 per cent on the cost of utilities involved." The report further states, "Of course, this sum includes field salaries and expenses. . . . but taken all in all, it is approximately 5 per cent of the contemplated work. . . . The usual commercial percentage for engineering service is but 5 per cent of the actual cost of executed work."

The 5 per cent in question is obtained by the committee from the ratio of total engineering expense of all kinds, including not only fees and overhead, but the cost of all field parties combined, to the total cost of all utilities. The inference conveyed by the Senate report is first, that the chief engineer misstated the percentage cost for engineering service, and second, that the amount paid for engineering service was twice that ordinarily paid.

The statement as issued and prepared by the Senate investigating committee, and which has gone into the Government records, should not be allowed to stand unchallenged. The engineers engaged for this service were over one hundred of the leading enginering firms of the United States. Scarcely a man who was called upon refused to give service or questioned the very low scale of fee proposed, but all agreed to accept the much reduced rate as a war duty, and the engineering press and all engineers should stand by and see that a true statement of these facts is given to the public.

In addition to the engineering work on the utilities such as sewers, water-supply, street work, etc., a very large part of the engineers' time was taken up with other matters such as original land surveys, topographical maps, executive negotiations with municipalities and utility companies, grades for lots and housing, plats for filing dedication, etc. The Senate committee has charged all this additional expense up to the one item of utility costs. Naturally their percentage of engineering costs is in excess of the actual amount.

It is found by actual comparison of the moneys paid out that the engineering fee and overhead as referred to in the report of the Housing Corporation of Dec. 3, 1918, amounts to about one-fifth of the expense of engineering on utilities so that the actual percentage of the engineers' fees and overhead, exclusive of field expense, is one-fifth of 4.2 per cent, or 0.84 per cent, or less than 1 per cent, which confirms the chief engineer's statement in the report.

When the representative of the investigating committee made his comparison in his report to the Senate investigating committee, he entirely omitted and failed to account for the three lines of the chief engineer's report which say, "In addition to which (meaning the 1 per cent) the project engineer receives actual cost for his assistants, traveling expenses, and such obvious expenses as can be readily checked," which, of course, means as their contracts fully set forth, all the field expenses of supervising work.

The following statement of percentage of engineering costs of June 30, 1919, as applied to the different housing projects which were completed, may be of interest. The first column is the percentage of engineering costs for engineering service on utilities alone; the second column is the percentage of all engineering costs to the value of all work performed by engineers. The percentage of fees and overhead for the engineer or engineering firm was less than 1 per cent of the cost of utilities.

Project	Utilities Per cent	Total all Engineering Costs Per cent
Aberdeen, Md.	6.537	10.89
Alliance, O.	10.80	18.00
Bath, Me.	4.23	7.05
Bethlehem, Pa.	1.248	2.08
Bridgeport (a) Conn.	6.6	11
Bridgeport (b) Conn.	7.2	12
Charleston, W. Va.	7.2	12
Erie (East) Pa.	4.02	6.7
Erie (West) Pa.	3.114	5.19
Indian Head, Md.	2.4	4
Mare Island, Cal.	3.936	6.56
New Brunswick, N. J.	3.048	5.08
New London, Conn.	3.18	5.3
Newport, R. I.	2.028	3.38
Ningara Falls, N. Y.	3.39	5.65
Cradock, Va.	4.98	8.3
Truxtun, Va.	4.38	7.3
Philadelphia, Pa.	.006564	0.1094
Quincy, Mass.	2.616	4.36
Rock Island, Ill.	5.274	8.79
Moline, Ill.	3.054	5.09
Davenport, Iowa.	2.268	3.78
Waterbury, Conn.	2.994	4.89
Watertown, N. Y.	3.33	5.55
Average	4.075	7.561

The former chief engineer of the Housing Corporation was criticised in the Senate's report in connection with the loan made by the Housing Corporation to one of the public utility companies. The only basis upon which such criticism could be made was by absolutely ignoring the evidence on page 723 of the hearings before the Senate committee. That evidence is that the securities in the vaults of the Housing Corporation today have a market value of over twice the amount of the loan in question.

CHARLES P. CHASE,
Manager Engineering-Construction Division,
Washington, D. C. U. S. Housing Corporation.

Subdividing a Trapezoid

In R. B. McWhorter's letter giving formulas for use in dividing a trapezoid into strips of equal area, on p. 194 of the issue of Jan. 22, 1920, the first sentence of the right-hand column should read,

"This trapezoid is to be divided into six smaller trapezoids of equal size, each to contain 16.844 units."

The sentence beginning above the drawing should read,

"With both sides and the area of each trapezoid known, the widths are readily obtainable."

HINTS FOR THE CONTRACTOR

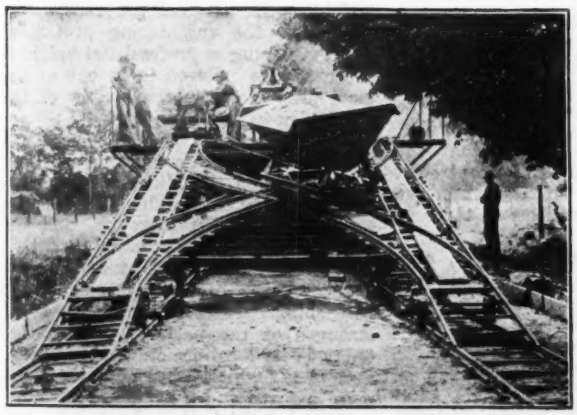
DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Portable Repair Plant for Dredges

FOR economy and convenience of repair work on a fleet of dredges operating at different points, a portable outfit is employed by the Yuba Consolidated Goldfields Co., California, as described in the *Engineering and Mining Journal* of Jan. 10, 1920, p. 86. A wagon-bed on four wheels has at the forward end an electric motor belted to an air-compressor mounted at the rear end and supplying power for pneumatic tools, while a portable electric welding apparatus is also carried on the machine. Forges and miscellaneous equipment can be hauled in trucks. Steel barges of 20 tons' capacity are used for transporting materials between the dredge and the temporary repair plant.

Traveling Bin Cuts Cost of Charging Paving Mixer

A MIXER charging machine, which comprises storage bins, a measuring cylinder and a track incline, all mounted on wheels, reduced the cost of handling materials to the mixer on two Wayne County, Michigan, concrete roads built in 1919. The structure is steel with the bins and measuring device at the forward end and



TRAVELING CHARGING BIN FEEDS PAVING MIXER

the track incline arrangement shown by the accompanying view. The capacity is 8 cu.yd. of stone, sand and cement. Cars of stone and sand arriving at the top are discharged into the bins and then returned to the surface tracks. Cars carrying cement in bags are held at the top while the bags are untied as needed and emptied through a hopper and chute into the mixer charging hopper which, when lowered, extends under the overhanging platform on top of the bins.

Two 24-in. gage industrial tracks spaced 10 ft. apart on centers on the subgrade carry the apparatus. These tracks connect by switches with the industrial track on the shoulder of the road. A stiff coupling connects the structure with the mixer so that when the mixer moves ahead it pushes the bins along.

On the two road jobs on which this device was used in 1919, it had, according to Leroy C. Smith, engineer-manager Board of Road Commissioners, Wayne County, Michigan, the following advantages: (1) It insured clean aggregates, accurately proportioned by machine, free from dirt shoveled off the grade. (2) It saved the cost of seven shovelers and seven wheelers, amounting, at the wage scale in force, to $70 per day, or reduced the labor cost about 10c. per sq.yd. (3) It made it possible to operate immediately after a rainstorm, even if the subgrade was muddy, because no material had to be picked off the grade. (4) It saved material, as no material was dumped on the grade and the usual loss of about 10 per cent of pebbles and sand was eliminated. (5) The subgrade was not cut up after fine grading had been completed.

Pipe for Hydraulic Fill Turned Often To Equalize Wear

TO insure an even wear around the circumference of the 15-in. manganese-steel pipes employed on hydraulic-fill operations of the Miami Conservancy District the pipes are turned 120 deg. for each new run, according to H. S. McCurdy in a paper before the New England Waterworks Association. Observation showed that practically all of the solids flow within the lower third of the pipe, the upper two-thirds being filled with water bearing only the lightest particles. Consequently, for a given run it is the lower portion of the pipe only which is subjected to any considerable wear. No difficulty is experienced in practice in turning the pipe; one end of each length is numbered 1, 2 and 3, 120 deg. apart, and each time a line is relaid the pipes are revolved until the next number is uppermost.

The pipes are slip joint, with a slight bell on one end, and are held together by wire stretched over hook lugs. The thickness of shell is $\frac{11}{64}$ in. The pipes are in 16-ft. lengths and weigh 28.83 lb. per linear foot. None of these manganese-steel pipes has worn out. Riveted steel pipe, made from ordinary steel plate containing 0.10 to 0.20 carbon, proved very shortlived. Claim has been made that the manganese pipe will last ten to fifteen times as long as 0.15 carbon steel.

The High Cost of Labor

As an example of the way in which the labor cost has increased, the *Bulletin of the Associated General Contractors* cites the case of a Minneapolis contractor who has furnished figures that show a labor cost of $78,600 in 1918 for a six-story warehouse, while in 1915 the charge for labor on a similar structure was only $49,000. The total cost of the entire building increased from $136,100 in 1915 to $251,000 in 1918. Contractors say that it is not only the higher wages now being paid to workmen that is responsible for higher building costs, but that the greatly lessened production per man is also a big factor. Two men at $2.25 a day did about as much work in 1914 as three men, each drawing $4.84 a day, will do at the present time.

NEWS OF THE WEEK

New York, February 5, 1920

New Plan for Seattle's Cedar Lake Dam

Sealing Operations Would Be Abandoned, New Dam and Tunnel Built and Plant Capacity Tripled

In a report just presented to Seattle's City Council, J. D. Ross, Superintendent of Lighting, urges that an entire change of policy be made immediately in regard to the Cedar Falls reservoir and power plant. It will be remembered that sluicing operations have been under way for two years in an endeavor to seal the reservoir so that water might be stored in it (see *Engineering Record*, and *Engineering News*, both volumes of 1915).

The leakage which is twice the average normal flow of the stream seems not to have been lessened and a continuation of the sealing operations, Mr. Ross says, "will result only in financial disaster and should at once be abandoned in favor of a plan that is better, quicker and perfectly sure." The new plan which would require only 12 months' working time, comprises three divisions. (1) making a rock-fill dam at the site of the old timber dam (which is about 7,000 ft. upstream from the concrete dam), (2) driving an 11-ft. tunnel 8,500 ft. long from above the proposed dam to connect with the existing tunnel and penstock line and (3) enlarging the power plant from 6,000 kw. to 18,000 kw.

A rock quarry opened some years ago is available near the dam site. The structure could be brought up to the height of the temporary spillway of the masonry dam and paved with concrete on both sides for about $150,000. The tunnel would be entirely through solid rock and could be driven from several adits. The intake end would be in the face of a steep rock cliff. This would raise the present water level of the lake 45 ft., increasing the storage to 80,000 acre-feet. The storage necessary to regulate the runoff of this basin, for records covering 15 years, averages 72,000 acre-feet, which would supply the 18,000 kw. contemplated. This amount of storage is considerably greater than could result from sealing, even if the operations were carried successfully to the full height contemplated.

By eliminating the present temporary structures the yearly cost of operating the enlarged plant would be actually less than present costs, Mr. Ross says. On the plan proposed the total installation cost would be $313 per kw. as against the installation cost of $582 per kw. on the plant as it now stands.

This year the lighting department paid one quarter of its receipts for fuel oil. If power from the Skagit development is not available until 1923, at the present rate the city would then be paying $1,000,000 per annum for fuel. With the proposed enlargement at Cedar Falls plant serving the city, the fuel-oil bill could be cut $800,000 per annum and consumers now refused could be served.

With the report is a recommendation that a bond issue of $1,750,000 be considered at once to provide for carrying on the work. The estimated costs are as follows:

Bringing old Cedar Lake dam up to a height of 30 or 35 ft. by means of a rock fill..	$150,000
Driving 8,500 ft. of 11-ft. tunnel including head gates..	1,100,000
Transmission and substation labor, machinery and equipment	500,000
Total	$1,750,000

The report was presented to the Seattle City Council and has been placed on file without action.

Committee Control for M. I. T.

At a meeting of the executive committee of the corporation of the Massachusetts Institute of Technology, Jan. 27, it was decided that no acting president will be appointed to fill the vacancy caused by the death of Dr. Richard C. Maclaurin, and that the affairs of Technology will be controlled by a subcommittee of the executive committee and a committee of three of the faculty.

The corporation subcommittee, consisting of Everett Morse, chairman, Francis H. Hart, and Edwin S. Webster, will keep in intimate touch with the affairs of the Institute and will cooperate with the faculty and officers of administration. The faculty committee, named the Administrative Committee, consists of Dr. William H. Walker, director of the new Division of Industrial Co-operation and Research, chairman; Dr. Henry P. Talbot, chairman of the Faculty and head of the Department of Chemistry, and Prof. Edward F. Miller, head of the Department of Mechanical Engineering. The latter committee will be charged with those duties ordinarily performed by the president in relation to the educational affairs of the Institute.

President Signs Niagara River Bridge Bill

On Jan. 30, 1920, the President signed a bill appointing a commission to investigate and report to Congress on the project of constructing a bridge across the upper Niagara River at Buffalo.

Annual Meeting of Engineering Institute of Canada

Reports Show That Institute and Its Branches are in Flourishing Condition

The thirty-fourth annual meeting of the Engineering Institute of Canada was held in Montreal Jan. 27, and was followed on the two succeeding days by the sixth general professional meeting. There was a total registration, including guests, of 650, which exceeded the number at any previous meeting.

Summarizing the year, the council of the institute laid special stress on the new spirit of the organization. "Service to the individual member," its report said, "to the branches and to the engineering profession has been the constant aim of the council during the past year. The spirit of service has been one of evolution, spreading over a number of years until it is now fully recognized and firmly established as a basic principle underlying the policy of the institute. It has been exemplified in many ways in connection with the work of the institute during 1919, which, as far as real progress in coordinating the engineering profession and developing a professional spirit is concerned, is believed to be one of the most progressive in the history of the profession in this country."

During the year, the council reported, new branches were established at Sault Ste. Marie, on the Niagara Peninsula, in the Border Cities, along the Detroit River, and at Peterborough, and the Kingston branch has renewed its activities. Every one of the eighteen branches, the council reported, is in flourishing condition "so that the great strength of the national organization today is its local societies or branches, each one of which is becoming more and more a force and a factor in the community in which it is located."

The question of registration has occupied a prominent place in the activities of the institute during 1919. A special committee has drawn up a proposed act, the principle of which has been approved by the council, and which at the present moment is under active discussion in every province. In some instances, application for registration has already been presented to the local legislatures. Engineering classification and remuneration have also been sponsored by the institute. "These efforts," the report says, "although falling somewhat short of the results hoped for, have paved the way for a greater recognition of the value of engineering services."

The membership report showed a total of 3,657 at the close of 1919. The

report of the library committee carried the recommendation that additional appropriation be made for increasing the size of the library. Brief reports of progress were received from the committees on steel railway bridges, on international affiliation, on the Canadian Engineering Standards Committee, and on uniform boiler specifications.

RECOMMEND DEVELOPMENT COMMITTEE

The Ontario Provincial Division report suggested that the council take under advisement the appointment of a committee on development, and favorable action on the report now brings the matter before the council. This committee, it was recommended, should consider and report on: (a) The technical activities; (b) the internal relations and local associations; (c) the relation with other national societies and related organizations, and (d) the relation to public affairs.

A constitutional amendment was approved which would place the Montreal branch on the same basis as other branches, that is to say, rebate to it a certain percentage of the dues and let it defray its own expenses. Hitherto the expenses of the Montreal meeting have been borne by the headquarters organization. The amendment must now go to letter ballot of the members.

MEDAL AWARD AND NEW OFFICERS

It was announced that the Gzowski Medal had been awarded to Phelps Johnson, George H. Duggan and George F. Porter for their paper on the "Design and Construction of the Quebec Bridge."

Election of officers for 1920 was announced as follows: President, R. A. Ross, of Montreal; vice-president, Brigadier-General C. H. Mitchell, Toronto, and W. G. Chace, Winnipeg; directors, F. B. Brown and Julian C. Smith, of Montreal; A. R. Decary, Quebec; F. A. Bowman, Halifax; J. B. Challies, Ottawa; E. R. Gray, Hamilton; Guy C. Dunn and B. S. McKenzie, Winnipeg; J. R. Macredie, Moose Jaw; George W. Craig, Calgary, and H. M. Burwell, Vancouver.

PROFESSIONAL MEETING

The professional meeting was divided into three sessions, the first of which was devoted to engineering education, and brought forth a very unusual review of the state of engineering education in Canada and the ideals under which it is going forward.

The third day's papers included a very important exposition of the water-power policy of the Province of Quebec and the work of the Quebec Streams Commission by Olivier Lefebvre, chief engineer of the Quebec Streams Commission, and papers upon the public health act of Quebec and the evolution of the public roads problem in the province.

[*Comment on the outstanding features of this meeting will be found next week in the column entitled "Impressions Here and There."*—EDITOR.]

Pennsylvania Prepares To Put Own Crews on Road Construction

During the 1920 construction season Pennsylvania will have its own crews at work building important stretches of the primary state highway system. Not only will the State Highway Department have its own construction equipment, but it will open its own quarries and sand banks. Department engineers have found suitable stone and sand deposits in many new localities; and with hundreds of leases already in effect will be able to secure these materials at reasonable prices without delay. A new branch has been created which, under the direction of Chief Engineer W. D. Uhler, will have charge of the new activities. The superintendent of this division will be Donald M. Henburn of Philadelphia, recently selected chief of the Philadelphia Bureau of Street Cleaning, under Director of Public Works Winston.

Proposes Salaried Road Commission for New Jersey

Governor Edward I. Edwards, of New Jersey, has recommended in his annual message that the present New Jersey State Highway Commission be abolished and that three commissioners be selected in its place, who should receive adequate compensation. Governor Edwards has said that no board of eight unsalaried members can be expected to give the time necessary to deal promptly and efficiently with the intricate details involved in the expenditure of almost $10 000,000 per year, nor can such a board by meeting once a month properly dispose of the interlocking business of counties. The Governor says the commission should be in constant session.

California Faces Uncertainty in Prosecuting Road Program

As yet it is uncertain whether the ten-million-dollar construction program laid out for California highways in 1920 can be carried out. The uncertainty lies in the fact that there is not much demand for securities bearing as low a rate of interest as the 4½ per cent provided for in the $40,000,000 bond issue voted last year. The bond issue provides for about 1,650 miles of new construction not included in previous issues. In the past six months the engineering department of the Commission has been making surveys of these new routes.

If funds are available the first work will be the completion of the gaps in the trunk lines and the work on the county seat laterals. The coast route from San Francisco to the Mexican line and the valley route from San Francisco to Los Angeles, via Sacramento, are scheduled to be paved for their full length before the end of the year.

In commenting recently on the situation in California, A. B. Fletcher, chief engineer of the California Highway Commission, said, "The Commission has laid plans for road work in 1920 necessitating the expenditure of about $800,000 a month. But the bonds must be sold before the contracts may be advertised, and labor conditions must be stabilized, else the engineers cannot estimate, nor can the contractors bid, intelligently."

Governor Smith Asks Road Funds

Governor Smith, of New York, has recommended to the legislature the prompt release of the $10,000,000 unappropriated balance of the second $50,000,000 bond issue available for road construction purposes. Quick action in the matter is sought because practically all of the appropriated balances have been expended and little is available to carry on the 1920 construction program. The governor also recommended that the legislature appropriate enough funds to match Federal government moneys available, which must be met on or before June 20.

Governor Smith is disposed to favor the further construction of New York highways, after the present available moneys are expended, through the "pay as you go" plan, whereby all construction costs would be met by direct appropriations. His favoring such a plan results from his belief that it has not been demonstrated that the so-called durable types of pavement have actually outlived the life of the bonds that provided the money for their construction.

Road Data To Be Given Contractors Ahead of Bid Advertising

In order that contractors interested in road construction work may thoroughly study projects before they submit bids upon them, the state highway commission of Montana has undertaken the preparation and distribution of a bulletin covering the 1920 program giving such pertinent information as location of projects, character and extent of improvement and the physical conditions to be encountered on the work. With the dissemination of such information, the road contractor will be given justification for investigating possibilities of using his outfit on the type and character of work proposed. When it is known that the 1920 program contemplates the construction of approximately 1,000 mi. of gravel surface type alone, the desirability of having this information available to contractors is obvious.

Tentative Plans for Highway Contract Lettings in Illinois

Beginning Feb. 11, 1920, bids will be received for from 60 to 100 mi. of highway every week until March 17. After that date the schedule will depend upon the activity of contractors in seeking work, and upon the market conditions

in other respects. Subject to change in detail, the Illinois Division of Highways will receive bids as follow:

Feb. 11—Marengo to Elgin, 12 mi., and perhaps an additional 13 mi.; Franklin Grove, 1 mi.; Ridge Farm to Marshall, 29 mi., and Decatur to Monticello, 28 mi.

Feb. 18—Chillicothe to Henry, 10 mi.; Monmouth to Galesburg, 7 mi.; east of Kankakee, 6 mi.; Springfield to Jacksonville, 10 mi.; south of Centralia, 18 mi.; Collinsville, 1 mi.

Feb. 25—At Dixon, 3 mi.; Rockford to Freeport, 21 mi.; Springfield to Jacksonville, 30 mi.; south of Centralia, 26 mi.; south of Du Quoin, 20 mi.

For March the schedule is not finally decided, but the mileages to be contracted will be: For March 3, 65 mi.; March 10, 20 mi. and March 17, 115 mi. The total of the figures given is 435 mi. planned to be contracted for by about the middle of March.

Building Officials' Conference in Chicago

The sixth annual meeting of the Building Officials' Conference will be held in Chicago Feb. 16, 17 and 18. Arrangements are being made to hold a joint session with the National Conference on Concrete House Construction. Pertinent discussions will include: Architect and design; community planning; financing homes; fire protection; monolithic houses; concrete block and unit-constructed houses.

Garbage-Reduction Contract Awarded by Rochester

A contract for a complete garbage-reduction plant on land owned by the city, the contract including all necessary buildings and equipment, was awarded by the City of Rochester, N. Y., on Jan. 26, to the C. O. Bartlett & Snow Co., Cleveland, Ohio, for $645,780. The plant has a nominal capacity of 128 tons a day and a maximum peak load capacity of 180 tons a day. According to reports of the commissioner of public works, the amount of garbage collected in Rochester in 1919 totaled a little over 30,000 tons. E. A. Fisher is consulting engineer to the City of Rochester and C. Arthur Poole is city engineer.

Union Depot Ordinance Lapses

Through refusal of the Pennsylvania R.R. to join in the enterprise for the construction of a union terminal station at Cleveland, to front on the Public Square, the ordinance passed by the City Council and subsequently confirmed by popular vote, permitting such construction, lapsed on Jan. 1, 1920. On Dec. 29 the City Council considered amending the ordinance so as to allow the railroads, other than the Pennsylvania, to proceed alone, but this vote failed to receive a majority. Planning is now in progress to revive the project on a slightly modified basis.

Illinois Contractors Discuss Highway Work

Discussion of combination bids, allowances for cement storage, time required between notification of work and receipt of bids, the contract letting schedule for 1920 and changes in highway specifications, brought out useful information at the open session on Jan. 15 of the annual meeting of the Illinois Association of Municipal Contractors.

Referring to the highway construction contemplated, Chief Highway Engineer Clifford Older, outlined the schedule of contract lettings for 1920 and stated that it was the purpose to have the plans ready and to announce the work three weeks ahead of the date of closing bids, but also stated that if contractors generally were satisfied with two weeks' notice this would be adopted. An informal vote of the contractors present indicated that preference was about equally divided between the two periods.

Query in regard to the proper allowance to be made to contractors for storing cement developed the conclusions that the cost was alike in no two cases and ranged from 10c. or 15c. a barrel, where storehouses were already available, to 40c. or more a barrel where storehouses had to be built. The State Highway Department has not yet decided what it will do except in the respects that the allowance will be figured on the peak storage prior to July 1, that the allowance will be a flat amount per barrel, and that the contractor will be responsible for damage in storage.

Changes in the specifications for 1920 highway contracts, said Mr. Older, provide first the adoption of a concrete slab uniformly 8 in. thick, on a crowned subgrade. This increases the volume of concrete by an amount represented by a ½-in. layer over the total width of the slab. Machine tamping will be required and hand tamping will not be allowed except by written order as an emergency operation in case of a tamping machine breakdown. Job slump tests last year proved impracticable because of the difficulty of pulling the cylinder without distorting the column of concrete. Experiments made with a frustum of a cone 12 in. high and 4 in. across at the top and 8 in. across at the bottom indicated that it could be used satisfactorily for field tests and it will be specified. A maximum slump of 1 in. will be specified. For grading, the 10-ton roller will not be required. Attention will be given to building up fill in layers and any light motor-roller will meet requirements.

Combined bids, as they are now handled, were criticized by a number of members as reducing the chances which the one-outfit contractor has of securing road work. The large contractor, it was asserted, in bidding on several sections, unbalanced his separate section prices, naming a very low price on the one or two sections for which the local small contractor could compete and boosting his price on the other sections to make his average price profitable. It was asked that the State Highway Department rule that wherever the one-section bid of the local contractor was less than the average price of all sections in the group-bid it should be considered the low bid. Speaking for the small contractor, one member stated that unless a change was made in the practice of handling combined bids, he saw the one-outfit contractor reduced to the necessity of sub-contracting at a less price if he wishes to construct roads.

Spirited Discussion of Contractors' Relations at Indiana Engineering Meeting

Highways, hydraulics of floods, relations with contractors, pumping by electricity, welfare and civic duty problems were subjects of interest to the civil engineer at the 40th annual meeting of the Indiana Society of Engineers held Jan. 23 and 24 in Indianapolis. About 60 engineers representing all of the local engineering organizations, A. S. M. E., A. I. E. E., A. A. E., and Scientech Club, participated in the evening session addressed by Prof. F. H. Newell on "Progress of the Bill for a National Department of Public Works," W. J. H. Strong on "Advertising for the Engineer," and Judge Raymond Springer on "Americanization and the American Legion." In addition to these welfare subjects, Daniel B. Luten outlined at another session the status of the combined engineers and architects license bill which has been twice before the Legislature and will be pushed again, and George B. Hubley spoke of a similar engineers and architects combined bill covering all classes of engineers, introduced into the Kentucky Assembly by the Engineers' and Architects' Club of Louisville. An opposition bill exempting the state highway engineer has also been introduced.

C. D. Franks started a lively discussion by his paper on "The Contractor and the Engineer—Their Relations," in which he quoted the appeal of R. G. Collins, Jr., in the *Engineering News-Record* of Jan. 15, p. 122. He added that the engineer should be a party to the get-together meeting proposed and extend his aid toward the removal of the contractor's hazards. Along this line he instanced the work of the uniform cost accounting committee appointed Dec. 2, 3 and 4 at a meeting of the Wisconsin Highway Commission with 200 representatives of the road building forces, including county engineers, contractors, machines and materials interests, which will collect data on the factors affecting costs and estimates so that the information may be available to all concerned. The committee consists of five men representing state and county interests, five the contractors and one each the machinery and material manufacturing interests. Mr. Franks divided the hazards into two classes; (1) those for which an accounting cannot easily be made, weather,

labor shortage and inadequate transportation; (2) those which can be definitely calculated, such as revision of freight rates. He believes that the hazard of the second class at least could be better and more economically assumed by the public. Not much favorable response was accorded Mr. Franks.

Daniel B. Luten felt that the contractor preferred the "thrills and romance" of assuming all the risks and Charles Brossman stated that his experience in attempting to assist the contractor much beyond his ordinarily prescribed field was vigorously resented. W. J. Titus held that the finances at the disposal of the engineers' department were usually so inadequate that more and better information could hardly be expected. Until salary rates were increased commensurate with responsibilities a higher grade of service for the contractor could not be expected.

R. C. Yeoman, in his paper on "Relation of Gravel Specifications to Production," indicated the difficulties the producers were under due to the numerous standards called for. However, various counties are, he said, adapting their specifications to meet local supplies and a co-operative movement was under way looking toward the adoption of a much smaller number of grades. Producers of the State, he reported, have increased their capacity from 50 to 100 per cent to meet the requirements of the Indiana road program which calls for expenditures three to four times normally made.

Lets Contract for Buildings in the Levant

The Standard Oil Co. has contracted with the Austin Co. of Cleveland for a number of the latter's standard factory units to be erected in the Levant. There will be two groups erected as distributing centers for the oil company in Turkey, one in Bulgaria and one in Greece.

The units ordered vary in size from 40 x 50 ft. to 100 x 500 ft. The largest single group will be in Greece. An erecting force of the Standard Oil Co. left New York City Feb. 1 for Constantinople, Turkey, where the first erecting will be done. Edward H. Beckert, construction engineer for the company, will direct the work which it is expected will last two years.

Madrid Subway Construction Resumed

The construction of the Madrid subway will be continued beginning in Jan. 1920, the representative of the *Engineering News-Record* in Madrid has been informed. The first three miles of this construction was completed last November, and is now operating from the northern part of the city to Puerta del Sol, the center of the business district. The new construction will carry the line to the station of the eastern and southern railways, Estación del Mediodia.

More London Underground Railways

Improvements and extensions of the electric underground railways of London, England, as decided upon by the several companies, are estimated to cost about $25,000,000. The Central London line will be connected to the suburban system of the London & Southwestern Ry. to open up an alternative route from the Hammersmith district into the city, while it will be extended parallel with the Great Western Ry. as far as the suburban district of Ealing. The old City & South London line, the first and smallest of the "tube" lines, is to be entirely rebuilt, its tunnel being enlarged to the same section as the other lines so as to accommodate the same rolling stock and permit the running of through trains. It will also be connected with the Hampstead line for through traffic between the northern and southern districts of London.

U. S. Firm To Build Hydro-Electric Plant in Japan

A contract for the design and construction of a large hydro-electric plant located on the Kiso River in the vicinity of Nagoya, Japan, has been awarded to Stone & Webster of Boston. The plant will be of reinforced-concrete type and will be planned to develop 30,000 hp. The operating head is to be about 110 ft. and it is expected that the power obtained will be distributed in the plant's locality for industrial use. H. B. Sawyer and C. F. Wallace will have charge of the work for the contracting firm. Y. Hatakayama is chief engineer for the owners, the Kiso Electric & Industrial Co., Ltd., Nagoya, Japan. The estimated cost is about $5,000,000.

Ontario Road Plans Made

The new Provincial Government of Ontario has come to a complete understanding with the Dominion Government as regards its good roads policy and is now in a position to avail itself of the full amount of the Dominion appropriation for road construction. On Jan. 14 F. C. Biggs, Provincial Minister of Public Works, held a conference with the Canadian Good Roads Commission and outlined the policy of the Government, which involves the taking over of 1,600 miles of county roads as provincial roads. The Provincial Government will pay 42 per cent of the cost of these roads, the federal grant will be 40 per cent, and the remaining 18 per cent will be borne by the municipalities.

The Province will also aid in the construction of township roads, of minor importance to those taken over, by paying to the townships 20 per cent of the cost, the work of construction to be done under Government supervision, the Government paying 40 per cent of the salaries of road superintendents. It is proposed also to abolish native labor. The proposals met with the entire approval of the Good Roads Commission and the Province will, during the next five years, receive $6,000,000 of the Dominion Government grant.

Passaic Valley Sewer Work To Be Investigated

At the initiative of the city authorities of Newark, N. J., an engineering investigation of the work of the Passaic Valley Sewerage Commission in building a joint outlet sewer for a group of municipalities is being carried out. Clyde Potts and C. C. Vermeule have been named as engineers in charge of the investigation in conjunction with engineers of the Department of Streets and Public Improvements of Newark.

Construction work on the sewer has been going on for nearly ten years and all predictions as to the expenditure necessary to complete it have been repeatedly surpassed. No part of the system is as yet in operation, and since the outfall portion is incomplete and work on it at present is in abeyance, pending the decision of a suit over the third contract for its construction, there is no fixed prospect as to when the sewer can be put into operation.

Tunnel Air Investigation Cancelled

In the appropriations committee of the House of Representatives last week the proposed experimental study of air conditions in vehicle tunnels on the part of the Bureau of Mines was killed, the scheduled appropriation of $100,000 asked by Director Manning being cancelled. It is reported that the committee believes such investigations are not the proper function of the Bureau.

Conferees on Rail Bill Reported Nearer Agreement

After several days without announcement of further progress in agreement between the House and Senate committees engaged in adjusting the differences of the two railroad bills, the conferees were reported, early this week, nearer agreement on the principal points at issue. At this writing, however, the deadlock appears still to exist on Section 6 of the Cummins bill, which provides for the distribution of "excess" earnings, giving part to the carrier, part to labor and part to the General Transportation Fund. According to the opinion of many in close touch with the situation, other points of conflict between the two bills will be adjusted without great difficulty as soon as agreement is reached on Section 6. Senator Cummins has denied absolutely that all but himself abandoned this section.

Consulting Engineers Elect New Officers

The Council of the American Institute of Consulting Engineers, Jan. 20, elected the following officers: Alexander C. Humphreys, president; S. Whinery, vice-president; F. A. Mollitor, secretary-treasurer.

Michigan Society Discusses Union with A. A. E.

With the exception of two papers on highways, the forty-first annual meeting of the Michigan Engineering Society, Jan. 28, 29 and 30 at Lansing, was devoted to organization, welfare and social-relations subjects.

Amalgamation with the American Association of Engineers will be effected if the expression of opinion by the unanimous vote (only one nay vote recorded) of members present is any indication of the letter ballot ordered. Since this will be the first of the large state societies having local clubs and chapters of their own to work out the state link with any national organization, a whole session was given up to an explanation of the plan which had been worked out by an affiliation committee in consultation with the executive committee of the American Association of Engineers. Briefly the arrangement provides that the Michigan Engineering Society retain its name and autonomy, that it handle all state questions and those involving districts within the State larger than the territory under the jurisdiction of a chapter. It will take charge of further organization of local clubs and chapters, which shall in turn be autonomous and retain practically the same amount of money as heretofore allowed American Association of Engineers' chapters. The several existing local clubs of the state society will be added to the two local chapters of the A. A. E.

Apportionment of the $10 dues tentatively decided upon is on a fifty-fifty basis between the State and national organization. For the first year the state society will get $2 and the local $3 as an incentive to get new members, thereafter the State will get $3 and local $2. Initiation fees also are to be halved. Last year the State society had 330 members and collected $5 dues which, added to the advertising in the proceedings, netted it $2,300. It is estimated that the state organization's share of the increased membership will enable it soon to afford a full-time secretary.

Indicative of the work the state organization proposes to take up are the names of the following committees the officers were asked to appoint: constitutional amendments; membership; internal relations; external relations with other states; legislation; registration law enforcement and amendment; practice; code of ethics and publicity; curricula of engineering schools.

The newly elected officers are as follows: president, W. W. Cox; vice-president, O. E. Eckert; treasurer, Prof. A. J. Decker; director, R. W. Roberts. J. H. Bateman, Ann Arbor, was appointed secretary by the executive council.

Zoning for Providence Urged

A city zoning plan for Providence, R. I., is urged in the recent report of the City Planning Commission.

Engineer Societies Resent Art Commission's Aspersion

Meeting for the first time in three and one-half years, more than 100 members of the Society of Municipal Engineers of Philadelphia on Jan. 29 unanimously passed a resolution refuting the statement attributed to the Pennsylvania State Art Commission to the effect that an architect rather than an engineer should design the proposed Philadelphia-Camden bridge. The statement concerned was a letter signed by the commission's secretary and published in these columns last week. A copy of the Society's resolution is to be sent to the governors of Pennsylvania and New Jersey.

Another organization, the Engineers' Society of Western Pennsylvania, at a recent meeting passed a resolution urging county commissioners to require the county engineer to pass upon the safety and economy of all bridge plans prepared by architects.

Sewage Works Contract Awarded at Cleveland, Ohio

The contract for building the Easterly sewage works at Cleveland, Ohio, for which bids were received the second time on Jan. 16, 1920, has been awarded to the American Construction Co. for $312,933. The contract for the Westerly sewage works was let some months ago, so that now the city of Cleveland has some 75 per cent of its sewage works program under contract, there remaining the Southerly plant which has been left for the last. Robert Hoffmann is chief engineer, Department of Public Service of Cleveland, and George B. Gascoigne is sanitary engineer in charge of sewers and sewage disposal.

Consolidation of Chicago's 24 Local Governments Urged

Consolidation of the 24 separate local governments in the City of Chicago is urged by the Chicago Bureau of Public Efficiency as an item in the revision of the State constitution. These governmental agencies comprise the city, Cook Co., the Sanitary District, the Board of Education, the Library Board, the Forest Preserve District, the municipal tuberculosis sanitarium, and no less than 17 park commissions.

"Pork Barrel" Bills Cut

As a result of the economy campaign which has been adopted by Congress, the River and Harbor Bill for which $43,000,000 was estimated has been cut to a lump sum approximation of $12,000,000. The Committee on Public Buildings and Grounds has reversed itself on the matter of a public buildings bill and it is now announced that there will be no appropriation authorized for the omnibus buildings bill which it was the intention of the committee to bring up.

Illinois Engineers See Necessity for Wider Activities

Backward conditions of sewerage and sewage disposal, land or property surveying as a branch distinct from engineering surveys, the proposed radical changes in specifications for brick paving and closer co-operation of engineering societies were the high points of the annual meeting of the Illinois Society of Engineers held at the University of Illinois Jan. 21 to 23.

Registration of surveyors in counties of over 250,000, it was brought out, is required by a new law, but as this applies only to Cook County and Chicago the State board has declined to take charge, so that the operation has been assigned to the county recorder. In this connection, M. L. Greeley, Chicago, disapproved of the proposed registration law of Engineering Council. Although this would apply to surveyors, he found that the committee had not consulted with surveyors and was not well informed as to laws dealing with their registration. The bill as drawn would give engineers and architects the right to make land surveys, but Mr. Greeley considered that it should require the establishment of property boundaries to be made by registered land surveyors. One objection urged against the Illinois law is that it seems to apply only to surveyors in private practice, so that assistants and employees of city and county departments cannot procure licenses.

Suggestions for co-operation and wider activities were presented, with explanation of the work of the general committee of Chicago technical societies. One proposal was to enlarge the scope of the society by including mechanical, electrical and mining engineers, the membership at present being confined mainly to civil engineers and surveyors. Plans were suggested for greater activity throughout the year.

Resolutions were passed in the following matters: Endorsing the co-operative work of the general committee of Chicago technical societies and urging that committee to arrange for representation at the State constitutional convention; recommending a study of the license laws of various states with a view to providing for reciprocity between the states, and recommending progress on the topographic maps of Illinois and the United States with a view to their completion by 1932. The officers for 1920 include the following: President, F. C. Lohmann, Champaign, Ill.; vice-president, S. A. Greeley, Chicago; secretary, E. E. R. Tratman, Wheaton, Ill. The next annual meeting will be held at Chicago in 1921.

Washington Office Opened by Reclamation Interests

Interests working for the adoption of the $250,000,000 Reclamation Bill have united in authorizing the opening of a Washington office from which their campaign will be directed.

Idaho Irrigation Congress

The third annual convention of the Idaho Irrigation Congress was held in Pocatello, Idaho, Jan. 12, 13 and 14. The first day's program was given over to the amalgamation of the Idaho Society of Engineers into a state chapter of the American Association of Engineers and a program devoted to highway subjects.

The officers elected for the ensuing year are A. V. Tallman, president; J. C. Wheelon and Chas. H. DeCamp, vice-presidents; and J. E. Badley, secretary-treasurer. Next year's convention will be held at Nampa, Idaho.

Contractor Awarded Extra Compensation on Tunnel Work

Patrick McGovern & Co., New York contractor, has been awarded $285,000 for extra work involved in a contract for the construction of a section of the Dorchester Tunnel, Boston, Mass. The case involved the construction of a portion of the tunnel under Fort Hill Channel. The final plans showed an all-earth cut, but after progress had been made on the project, rock was encountered. This fact was communicated to the Boston Transit Commission and the contractor was informed that extra compensation would be granted. This compensation was withheld at the conclusion of the contract. It was brought out in the case, heard before the U. S. District Court, that the Boston Transit Commission was aware of the existence of rock ledge, that borings had been made and records placed on file. On the final plans, prepared for carrying out the work, the presence of rock ledge was not noted. In the opinion of the court this fact was evidence of bad faith in that it amounted to concealment of material facts from the bidders. The contention of the Boston Transit Commission was that the probable occurrence of ledge was covered in a special clause of the contract agreement.

Wants $25,000,000 for Barge Canal

Edward F. Walsh, superintendent of public works of the State of New York, in a speech before the New York Civic Club last week said that the State of New York must appropriate something like $25,000,000 for the construction of canal terminals and elevators at New York, Buffalo and Oswego, or the New York State Barge Canal, on which there has already been spent about $155,000,000, would not be able to function. There is about $2,000,000 still unexpended of the money appropriated for the canal, but this is obligated by outstanding contracts. In the opinion of the superintendent, the canal will not be able to get business enough to make it worth while unless there are at its terminals state-owned grain elevators of considerable size.

U. S. Geological Survey To Map Haiti

At the request of the Republic of Haiti, a corps of engineers has been organized under the direction of Lieutenant Colonel Glenn S. Smith of the Geological Survey to make a comprehensive topographical survey of that country. Lieutenant Colonel Smith left Washington Jan. 18 for Haiti with E. L. McNair, who will be topographical engineer in charge of the work.

A bill is now pending in the Cuban Legislature providing for an appropriation of $1,000,000 to be expended over a period of ten years at the rate of $100,000 a year for a similar topographical study of Cuba. It is the opinion of Lieutenant Colonel Smith that that bill will become a law and that the Geological Survey will co-operate with the Cuban government in the same manner as it now is with the Dominican Republic.

Purchase of Water-Works of Spring Valley Water Co. Proposed

Purchase of the water-works of the Spring Valley Water Co., by the City of San Francisco is again proposed. The Board of Supervisors has passed a resolution authorizing the mayor and special water committee to ask the State Railroad Commission to value the property. The resolution also proposes that after the commission has named an "equitable price" a proposition to buy the work be submitted to popular vote. Purchase has twice been voted down.

Enlargement of Baltimore Water-Supply Recommended

Enlargement of the Baltimore (Md.) water-supply at a cost of $17,884,103 and purchase of the plants of nine private water companies for $3,900,897 is recommended in a preliminary report on the needs of the greater city by Nicholas S. Hill, Jr., and James H. Fuertes, consulting engineers, New York City.

Barrett Company Plans Road Lectures

A series of lectures upon highway work with special reference to the use of coal tar products have been arranged by the Barrett Co., 17 Battery Place, New York City. The lectures will be given upon application, to engineering societies as well as schools and colleges specializing in highway engineering. The series includes the following subjects: the chemistry, manufacture and control testing of refined tars; the laboratory tests to which road tars are subjected; construction of pavements with refined tar; city pavements of the block type; wood preservation; maintenance. The lectures are to be given by the members of the engineering department of the company.

Col. Beach as C. of E. Voted by Senate Military Affairs Committee

(Washington Correspondence)

By a unamious vote Feb. 3 the military affairs committee voted to recommend to the Senate the confirmation of Col. Lansing H. Beach who recently was nominated by the President to be Chief of Engineers, U. S. Army. Two meetings of the committee were necessary before a decision was reached.

Opposition to the confirmation was voiced by several senators on the ground that a man who had not been with troops for more than twenty years should not be placed at the head of a combatant corps. The opposition on this score was overcome, and while it may be raised again when the confirmation comes before the senate, there is no doubt in official circles as to the prompt confirmation of Colonel Beach.

Operating Contract for Street Railway Terminal Subways

A form of contract between the City of Cleveland and the local street railway company has been drafted by the city's transit commissioners, and this form was submitted to the city council last week as a proposed ordinance. It is understood to provide for payment of rental by the company to the amount of 60 per cent on the cost of track and appliances. Pending formulation and approval of this contract no further progress has been made toward securing referendum approval of the $15,000,000 bond issue required for construction of the terminal tunnels. The referendum vote is likely to be taken in April, it is now believed.

Detroit Subway Grade Crossings Obviated by New Lines

Consideration of the details of Detroit's proposed subway dips to relieve congestion of traffic on downtown streets, has been indefinitely postponed by the city council's vote to withdraw the so-called Castator plan which proposes subways for the street cars in the downtown section.

The necessity of spending $8,500,000 for subway dips is obviated by the several crosstown lines proposed by Mayor Couzens in his new street car plan. The mayor's plan, for which a bond issue will be voted on by the electors of Detroit, on April 5, provides for the construction of 100.75 miles of new line at an estimated cost of $70,000 per mile and taking over 34.75 miles of line built by the Detroit United Railway under existing agreements, and 21.25 miles of lines on which franchises have expired, all at an estimated cost of $40,000 per mile.

It is estimated that the remainder of the proposed $15,000,000 bond issue will provide finances for 400 motor cars and 150 trailers, with $1,000,000 allowed for providing car shops and miscellaneous equipment.

Spokane's Road Program

In July, 1919, Spokane Co., Washington, passed a bond issue of $3,250,000 for a trunk line road system. The interest and principal for this bond issue is to be taken care of by an additional one mill tax levy, which, in addition to retiring the bonds, will furnish $926,705 for additional construction.

The construction period is to end within the next five years. With the proposed bond issue and the Federal-aid offer, which it is proposed to take advantage of, and which, in turn, is estimated at $1,000,000, there will be made possible the construction of over 42 miles of graded roads, 93 miles of paved and 165 miles of macadam. H. T. Doolittle, formerly with the State Highway Department, has been chosen as construction engineer, and plans for this year's work are well under way.

It is estimated that this bond issue will make possible in five years' time the same amount of good roads that it would otherwise take forty years to build.

Urges Highway Department Buy Road Machinery

Legislation authorizing the purchase of road machinery by the State and the engagement of the State in highway construction directly is urged in the annual report of Frederick Stuart Greene, New York State Highway Commissioner, which was submitted to the Legislature Jan. 16. Commissioner Greene believes that through the State's buying its own road supplies and machinery and doing its own construction, an annual saving of $750,000 could be effected. Commissioner Greene's report indicates that during the eight and a half months he has been in office 260 contracts for constructing and improv-1,479 miles of road, at a cost of $22,-631,150, were awarded.

Boston Vehicular Tunnel Recommended

The report of the committee appointed to investigate the advisability of the construction of a vehicular tunnel under Boston Harbor has been submitted to the Massachusetts State Legislature. The commission recommended legislation for carrying through this project and requested extension of time for a more detailed study of the problem. The cost of this project will be about $11,000,000. John H. Cole, Commissioner of the Department of Public Utilities, is chairman of the committee.

New Federal Road District Formed

The United States Bureau of Public Roads has established a new district—District No. 11—comprising the states of Montana and Idaho. The new district, whose headquarters will be at Missoula, Mont., will be in charge of F. M. Keene who, as senior highway engineer, has been in charge of a former branch office at that place.

Town Civic Board Takes Up Railroad Problem

That others besides the numerous "lobbies" at Washington and parties immediately concerned are beginning to take an active interest in railroad legislative matters is indicated in the resolutions recently adopted by the Civic Board of Cranford, N. J., after considering the questions at issue. The resolutions follow:

Resolved—First, That this Board earnestly favors private ownership and operation as contradistinguished from Government ownership and operation, and looks with approval upon the proclamation of the President returning the roads to their owners on March 1st, thus affording an opportunity for Congress, in the meantime, to enact proper protective legislation.

Second, That Congress, in the proposed legislation, should provide for the protection of the railroads during the transition period by the continuance of the standard return until a proper rate structure can be established, and by proper funding for a definite period of, say, ten years, of the obligations incurred by the carriers during Federal control, at the instance, or with the approval of the Director General, for additions and betterments. No attempt should be made to strip the carriers of quick assets, in order to pay this capital indebtedness to the Government. It is in the interest of the public that the carriers should not be required to resume with empty treasuries their transportation duties, on the efficiency of which the public is absolutely dependent.

Third, That a rule of rate making should be declared in the statute which will give assurance to prospective investors that the revenues under average conditions will be adequate to make their new investment safe. These revenues should be sufficient to provide for the expenses of operation, including taxes and the cost of labor, a fair return on the property already being used for the public service, and enough additional to give the roads proper credit to obtain the capital needed to keep their facilities and service up to the requirements of commerce.

Fourth, That this Board unqualifiedly condemns the novel doctrine now suggested of depriving any carrier of a part of its earnings at lawful rates. It regards such a proposal as a menace to the security of all property, and as opening the door to a socialization of our Government. It earnestly protests against the adoption of this dangerous principle.

Members of the board and other citizens of Cranford have transmitted copies of the resolutions, with personal letters, to the Congressmen of the State.

Instruction for Water-Filter Operators in Texas

Beginning Feb. 2, the University of Texas and the Texas State Board of Health will offer a two-weeks' free course of instruction to water filter-plant operators. The course will be given at the University of Texas in accordance with a plan worked up by the Bureau of Sanitary Engineering and the State Board of Health. V. M. Ehlers is chief of the Bureau and L. O. Bernhagen is assistant state sanitary engineer. Dr. C. W. Goddard is state health officer.

Emergency Ponton Bridge To Be Built by Army Engineers

Owing to the destruction of a bridge at West Point, Ga., a ponton bridge will be erected by the Engineer Corps, U. S. Army, for temporary use, pending the construction of a permanent bridge by the local communities.

Four Months' Publicity Nets 4,155 Column-Inches

Publicity of engineers and engineering obtained in a four months' contest by the various chapters and clubs of the American Association of Engineers amounted to the equivalent of two complete editions of the *Chicago Tribune*. As noted in the *Engineering News-Record*, Nov. 27-Dec. 4, 1919, p. 959, strings of newspaper clippings sent in monthly had added inches of credit for the word engineer in the headlines. The Globe-Miami chapter won the contest with 438 column-inches, almost three solid pages, to its credit. Toledo got 430 in., and Baltimore 359 in. In September 16 chapters submitted 503 in.; in October 23 chapters, 1,222 in.; in November, 17 chapters, 978 in., and in December, 19 chapters, 1,452 in. A publicity display will be arranged for the St. Louis convention May 10 and 11.

Providence Water Board Expects To Limit Construction in 1920

In view of the probable condition of the labor and materials market in 1920 the Board of Water Supply of Providence, R. I., according to its annual report for 1919, "is of the opinion that it will probably be wise to limit its construction program for 1920 to work which can be completed within the year." This means that the construction of the Kent dam, estimated to take four years, will probably not be started during the year, but it is likely that $500,000 will be spent on such preliminary work as culverts, bridges and roads. Frank E. Winsor is chief engineer of the board.

Oregon Highway Engineers Named

The Oregon State Highway Commission has appointed the following division engineers: Maison and Linn Cos., J. L. McLeod; Clackamas Co., C. H. Whitmore; Wasco, Crook, Deschutes, Hood River and Jefferson Cos., O. C. Kelly; Baker, Harney, Grant and Malheur Cos., R. H. Blalock; Wheeler, Morrow, Umatilla, Union, Wallowa Cos., and the John Ray River Section in Grant County, M. O. Bennett.

Nominations to Vacancies in Coast and Geodetic Surveys

Nominations to fill vacancies in the Coast and Geodetic Survey have been sent to the Senate by the President as follows: To be Hydrographer and Geodetic Engineer, Ray Longfellow Schoppe of Vermont; to be Junior Hydrographers and Geodetic Engineers, Lowrie W. Burdette of South Carolina, William M. Schaife of South Carolina and Earl O. Heaton of New York; to be Aides, R. F. A. Studds of District of Columbia, L. M. Zeakind of Maryland, H. C. Warwick of West Virginia, J. S. Rosenthal of North Dakota and Morris Kogan of Massachusetts.

Illinois Waterway Authorized by War Department

permit for the construction of the waterway connecting the Chicago drainage canal at Lockport, Ill., with the Illinois River at Utica, Ill., has been issued by the Secretary of War. Plans prepared by the Illinois Department of Public Works and Buildings provide for a channel of 150 ft. minimum bottom width and 8 ft. depth of water, or 10 ft. in rock. The locks will be 600 x 110 ft., with 14 ft. of water on the sills to provide for a future 14-ft. channel, if necessary. These locks will enable barge fleets of 7,500 tons to be passed without separation.

Except for a short cut-off the work will follow the channel of the Desplaines River. Water-power development is a part of the project, but for this the state is required to obtain the permission of the Water-Power Commission recently authorized by Congress. A bond issue of $20,000,000 for the waterway has already been approved by public vote in Illinois.

Army Equipment for State Highways

Without waiting on pending legislation, the Director of Sales has issued instructions that a quantity of surplus industrial railway material is to be turned over without funds to the Bureau of Public Roads for division among the State Highway Departments. Included in this delvery of materal are locomitives, rails and cars.

ENGINEERING SOCIETIES

Baltimore Chapter, American Association of Engineers, in its semi-monthly meeting Jan. 16, discussed the planning of boulevards in Baltimore's new annex and went on record as being willing to take charge of this work in lending its professional assistance to the city.

The Nebraska Association of Members of the American Society of Civil Engineers, Jan. 10, at the annual meeting in Lincoln elected the following officers: President, Clark E. Mickey; vice-president, Rodman M. Brown and John L. Hershey; secretary-treasurer, Homer V. Knouse, Omaha. The Development Committee report was endorsed. Los Angeles was suggested as the next meeting place for the annual convention of the parent society. Appointment was made, by request, of A. C. Arend as engineering representative on the advisory committee of the Omaha Building Department. This association has assessed its members in addition to the regular $2 dues, $2 for increased activities, $1.50 for Engineering Council and $0.75 (for Omaha members only) for the Assocition's share in the expenses of an Omaha Conference Committee consisting of representatives of leading business, professional and civic bodies interested in upbuilding the city.

Calendar

Annual Meetings

AMERICAN ROAD BUILDERS' ASSOCIATION, 150 Nassau St., New York City; Feb. 9-13, Louisville, Ky.

AMERICAN WOOD-PRESERVERS' ASSOCIATION; Feb. 10-12, Chicago.

AMERICAN CONCRETE INSTITUTE; Feb. 16, 17, 18, Chicago.

NATIONAL CONFERENCE ON CONCRETE HOUSE CONSTRUCTION; Secretary A. J. R. Curtis, 111 West Washington St., Chicago; Feb. 17, 18, 19, Chicago.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA; 111 W. Washington St., Chicago; Feb. 18-19, Chicago.

AMERICAN CONCRETE PIPE ASSOCIATION; 210 South La Salle St., Chicago; Feb. 20-21, Chicago.

AMERICAN RAILWAY ENGINEERING ASSOCIATION; 1426 Manhattan Bldg., Chicago; March 16-18, Chicago.

AMERICAN ASSOCIATION OF ENGINEERS; 29 S. La Salle St., Chicago; May 10, 11, St. Louis, Mo.

The New Jersey State Association of County Road Supervisors held its annual meeting at Trenton recently and elected the following officers: President, James A. Ross, Mercer Co.; vice-president, Stewart E. MacFarland, Burlington Co.; secretary-treasurer, T. E. Gibson, of Somerset Co.

The Engineers Subdivision of the Chicago Association of Commerce has elected the following officers for 1920: Chairman, John W. Alvord; vice-chairman, C. O. Billow; other members of executive committee, L. J. Hotchkiss, W. T. Reeves and R. Tencher.

The Minnesota Joint Engineering Board will hold its annual meeting and dinner for all engineers of the nine affiliated engineering societies in the state Feb. 20, 1920, in Minneapolis, Minn., and not Feb. 21 as was announced in the issue of Jan. 22.

The New England Water Works Association will hold its monthly meeting at the Hotel Brunswick, Boston, Feb. 11. The papers to be read are: "The Creation of a National Department of Public Works" by Prof. George F. Swain, Howard University, and "Economy in Pipe Lines for Small Water Systems" by Edward D. Eldredge, water company superintendent of Onset, Mass.

The Western Society of Engineers will be addressed by Herbert C. Hoover on Feb. 28, at which time he will be presented with the Washington Award for his services in promoting the public welfare as chairman of the relief commission for Belgium and as food administrator for the United States.

The Kansas City Engineers' Club held its annual dinner in Kansas City, Mo., Jan. 27. The members voted 143 for, and 38 against, amalgamation with the A. A. E. Those attending were addressed by J. C. Nichols on the subject of city planning with special reference to local needs in that line. The following officers were elected: Clark R. Mandigo, president; F. F. Shauer and A. Penn Denton, vice-presidents; William Bugg, treasurer; Forest Kauffman, secretary.

The Oregon Chapter of the A. A. E. has obtained increases in the salaries of engineers employed by the Oregon state highway commission, which brings the salaries of these engineers up to the minimum salaries recommended by the Association. This result is said to be largely due to the efforts of R. W. Barnes, secretary of the chapter.

The Ohio Assembly of the A. A. E. was recently organized to correlate the activities of the Association in Ohio. F. D. Richards of Cleveland is temporary president, and the temporary secretary is W. L. Martoon of Columbus, Ohio. A meeting of the assembly will be held in Columbus Feb. 28 at which a constitution will be drafted.

PERSONAL NOTES

CARL TOMBO, former principal assistant valuation engineer of the Philadelphia & Reading R.R. and the Central R.R. of New Jersey, with headquarters at Philadelphia, has resigned and taken up the private practice of engineering in the West, with headquarters at Placerville, Cal.

JOHN G. SULLIVAN, former chief engineer of the Canadian Pacific Ry., has been elected to the Board of Aldermen of Winnipeg, Man. Mr. Sullivan was assistant engineer of construction on the Panama Canal and directed the construction of the Cannaught Tunnel.

E. W. FASSETT, A. M., Am. Soc. C.E., recently received his discharge as captain of engineers, U. S. A., and is now with the Midwest Refining Co., Casper, Wyo.

NATHANIEL O. GOULD, who was released from the Air Service, U. S. A., in June, 1919, has been appointed structural engineer for the firm of Aaron H. Gould & Son, architects and engineers, with offices in Detroit, Mich.

ALBERT L. UPHAM, recently honorably discharged from the 23rd Engineers, U. S. A., after fifteen months' service overseas, is now located at Hartford, Conn., as field engineer for Stone & Webster.

GREEN SLADE has been appointed highway engineer for the Tenth Congressional District, Georgia. He will make his headquarters in Augusta, that state.

C. W. WEST, of Buchanan, Va., was recently appointed county road engineer of the Houghton County Road Commission.

N. M. MCCLUSKEY, of Clovis, N. M., has been named as district highway engineer of the Clovis district, to take the place of D. W. Jones, who has resigned to accept a position with the local chamber of commerce.

SILAS W. MCCONNELL, recently appointed, has entered upon the duties of city engineer of Steubenville, O. He succeeds John Leech, who resigned some months ago.

ROBERT T. JACOBSEN has been appointed city engineer of Fargo, N. Dak., in which capacity he has been acting since June, 1919. He fills a vacancy created by the resignation of Frank L. Anders, who resigned last summer to engage in consulting practice.

GEORGE GARRETT, who has been employed during the greater part of the last seven years as an engineer in the Public Works Dept. of Salem, Ore., has been appointed city engineer of La Grange, Ore.

C. R. ANDREWS, former captain of engineers, has been admitted to the firm of Miller, Holbrook & Warren, Municipal consulting engineers of Decatur, Ill. Before the war Mr. Andrews was one of a force of sixty engineers doing government work in the Wheeling River district. His work in France had to do with the construction of docks at the ports.

ORION KOLLER AND HARRY CONRAD who have engaged in the practice of engineering in Wheeling, W. Va., under the firm name of Koller & Conrad, recently dissolved their partnership. Mr. Koller will continue the business, while Mr. Conrad will give all his time to his new appointment as city engineer of Wheeling.

WILLIAM WARING has been placed in charge of the office recently opened in Boston by the Lakewood Engineering Co., of Cleveland, O. Mr. Waring was for the past two years connected with the Philadelphia and Washington offices of the Lakewood Co.

HAROLD L. TILLSON has been appointed by the Portland Cement Association to the management of its activities in Iowa. Mr. Tillson, whose headquarters will be in Des Moines, Ia., has been connected with the Association for more than three years, and since December, 1917, has been identified with its Iowa work.

PROF. GEORGE C. WHIPPLE, professor of sanitary engineering at Harvard University and member of the firm of Hazen, Whipple & Fuller, New York City, sailed from New York Jan. 30 to take up his work at Geneva, Switzerland, as head of the Division of Sanitary Engineering of the Bureau of Hygiene and Public Health of the League of Red Cross Societies. He has already been preceded by Colonel F. F. Longley of the firm named. An outline of the work which will be headed by Messrs. Whipple and Longley appeared in *Engineering News-Record*, Oct. 23, 1919, page 777. Thus far 28 nations well distributed through the world are included in the League of Red Cross Societies. The League is provided for under paragraph 25 of the League of Nations covenant. Professor Whipple expects to return to Harvard in September.

OBITUARY

ARTHUR W. PETERSON, for the past three years in the employ of the Providence Water-Supply Board as engineer on the Scituate dam, died at the Homeopathic Hospital in Providence, R. I., Jan. 12, following an operation for appendicitis.

ROBERT HOLLISTER CHAPMAN, a leading topographical engineer, associated with the U. S. Geological Survey at Washington for nearly 40 years, died in New York City, Jan. 11, of pneumonia in his fifty-second year. As a boy his interest in geology set him to work for the survey at the age of 12. In 1919 he was sent to Ottawa to introduce American methods into the Canadian Geological Surveys. His many explorations and surveys included those of Vancouver Island and Death Valley with the adjacent deserts and high sierras of California. In 1912 he acted as superintendent of Glacier National Park. With the rank of Major in the Engineers Reserve Corps he was on active duty in the war as assistant to General Theodore Bingham.

EDWIN F. SMITH, who retired in 1911 after 50 years of service with the Reading R.R. Co., died at his home in Philadelphia Jan. 26. Mr. Smith graduated from Union College, and served through the civil war with the 26th Pennsylvania Volunteers. He served on the board of engineers appointed by the Aqueduct Commission of New York City in 1901 to report on items of construction relating to the Croton dam, on a board investigating the condition affecting the Castlewood dam in Colorado, and on a board making a general review of the location and plans for the Nicaragua ship canal. Mr. Smith was a member of the American Society of Civil Engineers, the Franklin Institute and the Engineers' Club of Philadelphia.

FRED CREELMAN, secretary-treasurer of the C. L. Hyde Construction Co. of San Diego, Cal., died at his home in that city on Jan. 27 after a brief illness. He was a native of Canada but had resided in California for the past ten years. The company with which he was connected had handled a number of large highway construction jobs in recent years, including some on the mountain roads connecting the coast and the great Imperial Valley in southern California.

HARRISON G. BREWER for many years chief hydrographer and chief of the division of chart construction of the Navy Department, died Jan. 23, in Washington. Mr. Brewer had been employed in the Navy Department for more than 30 years. He graduated in Architectural Engineering at Johns Hopkins University.

R. WINTHROP PRATT, consulting engineer of Cleveland, Ohio, died there of influenza Feb. 2. At the time of his death Mr. Pratt had attained professional eminence in the fields of water supply and sewerage. Mr. Pratt graduated from the Massachusetts Institute of Technology in 1898 and entered the engineering department of the Boston & Albany R.R. In June, 1899, became assistant engineer of the Massachusetts State Board of Health where he remained four years. He left Massachusetts in April, 1903, to become chief engineer of the Ohio State Board of Health. In that capacity he continued until October, 1911, except for one year's leave of absence in 1909-10, when he was retained as consulting sanitary engineer by the Cuban government. Mr. Pratt resigned his office with the State Board of Health in the latter part of 1911 to carry on a private consulting practice jointly with the duties of an appointment as special sanitary engineer for the City of Cleveland. In July, 1913, he also became consulting engineer for the water department of that city. During Mr. Pratt's service on the health board of Ohio he personally investigated and wrote reports on more than 400 water-supply and sewerage projects for municipalities and public institutions in the state. In Cuba he supervised the design of water-supply and sewerage systems for various of the island cities, including a mechanical filtration plant for Santiago de Cuba. The water-filtration plant of Cleveland was designed and its construction supervised by Mr. Pratt. He also had charge of the important series of experiments begun at the Cleveland sewage-testing station in 1913. Aside from his Cleveland work, Mr. Pratt was engineer for many water-works and sewerage systems in Ohio and elsewhere, including a number of water and sewage treatment plants. Water-treatment experiments at Detroit were conducted under his direction in 1917-18. Mr. Pratt was a member of the Am. Soc. C. E. He was joint author with the late Prof. L. P. Kinnicutt and Prof. C.-E. A. Winslow of "Sewage Disposal," published in 1910 and revised in 1918. He was a frequent contributor to *Engineering News*.